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VIRUSES DESCRIBED PRIMARILY ON ORNAMENTAL OR MISCELLANEOUS PLANTS

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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Division of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

VIRUSES DESCRIBED PRIMARILY ON ORNAMENTAL OR MISCELLANEOUS PLANTS

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Introduction

The codification of published information bearing on the classification of plant viruses is one of the projects of the Committee on Virus Classification and Nomenclature of the American Phytopathological Society. This work was assigned to a number of sub-committees, each sub-committee being responsible for codifying information on the viruses described on a particular group of host plants. The sub-committee on ornamental hosts was originally headed by H. H. Thornberry and included the writer, F. A. Haasis, and F. P. McWhorter. With Thornberry in the armed service, the chairmanship passed to the writer in November, 1942. Inasmuch as the other members of the sub-committee have been too pressed with other duties to take active part in the work, the writer assumes full responsibility for the organization and content of this first draft.

Only those viruses that have been described primarily on ornamental or miscellaneous plants are treated, not those described primarily on crop plants but also affecting ornamentals. The attempt is made to list all viruses in this field for which experimental transmission is claimed, but the present list is tentative and doubtless incomplete. The decision as to whether a given virus is adequately described and sufficiently distinctive to merit a name is left open. The descriptions are objective, with citations to specific literature for most statements of critical importance. The writer has taken some liberties in designating common names for the viruses and has expressed some opinions under the headings "Remarks". The form of description is adapted from Hildebrand, Berkeley, and Cation, "Handbook of virus diseases of stone fruits in North America," Mich. Agr. Exp. Sta. Misc. Publ., May 1942. The names of host plants are usually given in the form reported by investigators and do not necessarily conform to Bureau usage.

The viruses are arranged alphabetically according to the generic name of their principal host plants.

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List of Viruses Described

Abutilon-variegation
(Acer) Maple-variegation
(Aesculus) Horsechestnut-variegation
Anemone-alloiophylly
Anthurium-mosaic
Atropa-mosaic
Boltonia-streak
(Callistephus) Aster-yellows
(Callistephus) California-aster-yellows
Camellia-yellow-spot
Canna-mosaic
Cephalanthus-mosaic
Convallaria-mosaic
Dahlia-mosaic
Daphne-mosaic
Datura-mosaic
Datura-"Quercina"
Datura-virosis
Delphinium-ringspot
(Dianthus) Carnation-mosaic
Emilia-variegation
Epiphyllum-mosaic
Euonymus-variegation
Fraxinus-variegation
Gladiolus-mosaic
Holodiscus-witches'-broom
(Humulus) Hop-chlorotic-disease
(Humulus) Hop-infectious-sterility
(Humulus) Hop-mosaic
(Humulus) Hop-nettlehead
Hydrangea-virescence
Hyoscyamus-mosaic
Ilex-variegation
Iris-mosaic
Jasminum-variegation
Laburnum-variegation
(Lathyrus) Sweetpea-streak
Ligustrum-variegation
(Lilium) Lily-rosette
(Lilium) Lily-symptomless
Lonicera-variegation
Matthiola-mild-mosaic
Matthiola-severe-mosaic
Narcissus-mosaic
Narcissus-white-streak
(Nerium) Oleander-variegation
Ornithogalum-mosaic
(Paeonia) Peony-mosaic
Passiflora-fruit-woodiness
Passiflora-variegation
Pelargonium-leaf-curl
Pelargonium-mosaic
Peperomia-ringspot
Petunia-mosaic
Phlox-streak
Phytolacca-mosaic
Pittosporum-variegation
Primula-mosaic
Prunella-mosaic
(Prunus) Flowering-cherry-rough-bark
Relea-variegation
Rhamnus-variegation
Robinia-brooming
(Rosa) Rose-mosaic
(Rosa) Rose-streak
(Rosa) Rose-wilt
(Rumex) Dock-mosaic
(Sambucus) Elder-mosaic
(Senecio) Cineraria-streak
Sorbus-variegation
Tabebuia-witches'-broom
(Tulipa) Tulip-breaking
(Ulmus) Elm-mosaic
(Ulmus) Elm-phloem-necrosis

ABUTILON-VARIEGATION VIRUS

Names: Abutilon virus 1 (Baur) Smith 1937
Marmor abutilon Holmes 1939

Synonyms: Abutilon Panaschüre (virus) Morren 1869
Abutilon Panachirung (virus) Lindemuth 1872
Abutilon infectious Panaschierung (virus) Baur 1904
Abutilon infectious chlorosis (virus) Baur 1904
Abutilon-mosaic virus Holmes 1939

Common name: Abutilon-variegation virus

Geographic distribution: Argentine (Soriano), Belgium, England, France, Germany, Sweden (Euler et al.), United States, West Indies (Cook).

Host range: MALVACEAE--Abutilon arboreum Sweet, A. darwini Hook., A. darwini var. tesselatum Hort., A. esculentum St. Hil., A. inaequale (Link & Otto) K. Schum., A. indicum (L.) G. Don, A. insigne Planch., A. megapotamicum St. Hil. & Naud. (= vexillarium), A. regnellii Miq. (Keur 1934), A. sellovianum Regel, A. striatum Dicks., A. striatum var. thompsoni Veitch, A. theophrasti Medic. (A. avicennae Gaertn.), A. venosum Lem., A. vitifolium Presl, many Abutilon hybrids and varieties, Althaea ficifolia Cav., A. officinalis L., A. rosea (L.) Cav., Anoda hastata (Willd.) Cav. (Lindemuth 1902), Kitaibelia vitifolia Willd., Lavatera arborea L., Malva borealis Wallm. (Hertzsch 1927), M. crispa L. (Hertzsch 1927), M. mauritiana L., M. sylvestris L. (Holmes 1939), M. verticillata L., Malvastrum capense (L.) Garcke, Modiola decumbens G. Don, Palava malvaefolia Cav. (Lindemuth 1902), Sida hermaphrodita (L.) Rusby (S. napaea Cav.), S. mollis, Sidalcea candida A. Gray (Lindemuth 1907, except as noted).

Symptoms: In leaves of Abutilon striatum var. thompsoni, yellow mottling often delimited by veins; in A. sellovianum, yellowish green mottling; in Kitaibelia vitifolia, yellowish vein-clearing; in A. indicum, nearly complete yellowing, with marked dwarfing and crinkling of leaves (Hertzsch 1927). Symptoms are illustrated by Lindemuth (1907), Davis, Hertzsch, Keur. Little histological difference between green and yellow areas, no x-bodies (Davis).

Methods of transmission: By grafting or other method of transplantation (Morren 1869, Lindemuth 1872, Baur 1904, etc.). Not by sap (Baur, Hertzsch, Davis, Klebahn 1931). Not through seed (Baur). Occasionally through seed (Lindemuth 1907 (?), Keur 1934).

Properties: Klebahn's evidence (1931, 1936) indicates at least 6 to 7 days' contact of cut surfaces is required for transmission of the virus, which apparently moves through parenchyma tissues.

Remarks:
This disease was originally recognized in England in 1868 in a plant of Abutilon striatum from the West Indies. Cook (1931) describes and

illustrates variegations in wild plants of A. hirtum (Lam.) Sweet in Puerto Rico, as well as in Sida carpinifolia L. and Andenoropium gossypifolium (L.) Pohl (Jatropha gossypifolia L.). Indications of natural spread are reported.

Infected plants of Abutilon striatum have been cured by removing successive crops of variegated leaves (Baur, Davis). Green shoots arising spontaneously on variegated A. striatum do not transmit the virus (Baur, Keur), but are susceptible to infection (Keur). Althaea officinalis fails to retain the virus through winter rest; other suscepts retain it for life (Lindemuth 1907). Of 3185 seedlings from variegated Abutilon spp., 461 showed variegations, and 4 of these were shown infected with transmissible variegations (Keur).

Two distinct types of infectious chlorosis are distinguished by Hertzsch (1927): the A type in Abutilon striatum thompsoni, the B type in A. darwini tesselatum. The A type commonly includes veinal chlorosis; the B type is interveinal. Abutilon indicum, A. sellovianum, Malva borealis, M. crispa, Althaea officinalis, and Kitaibelia vitifolia proved susceptible to both, but symptoms differ; Lavatera arborea was subject to B only; Althaea taurinensis DC., Sidalcea malvaeflora A. Gray (S. atropurpurea), and Sphaeralcea umbellata G. Don were immune to both. The B type can be superimposed on A in A. striatum, symptoms of both being expressed. Keur distinguished 2 types of infectious variegations in Abutilon clons; all clons tested were susceptible to both types.

Literature:

Baur, E. Zur Aetiologie der infektiösen Panaschierung. Ber. d. Deutsch. Bot. Gesellsch. 22: 453-460. 1904.

_____ Weitere Mitteilungen über die infektiöse Chlorose der Malvaceen und über einige analoge Erscheinungen bei Ligustrum und Laburnum. Ber. d. Deutsch. Bot. Gesellsch. 24: 416-428. 1906.

_____ Über die infektiöse Chlorose der Malvaceen. Königl. Preuss. Akad. Wiss. Berlin, Sitzungsber., 1906: 11-29. 1906.

Cook, M. T. New virus diseases of plants in Porto Rico. Journ. Dept. Agric. Porto Rico 15: 193-195. 1931

Davis, E. F. Some chemical and physiological studies on the nature and transmission of "infectious chlorosis" in variegated plants. Ann. Missouri Bot. Gard. 16: 145-226. 1929.

Euler, H. v., Hertzsch, W., Myrbäck, S., Runehjelm, D., and Forssberg, A. Chemical changes in infectious chlorosis in leaves of Abutilon. Arkiv. Kemi Mineral. Geol., x B, 13, 6 pp. 1930. (Swedish) (RAM 10; 475).

Hertzsch, W. Beiträge zur infektiösen Chlorose. Zeitschr. für Bot. 20: 65-85. 1927.

_____ Infektiöse Chlorosen. Der Züchter 2: 195-199. 1930.

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 50-51.

Keur, J. Y. Studies of the occurrence and transmission of virus diseases in the genus Abutilon. Bull. Torrey Bot. Club 61: 53-70. 1934.

Klebahn, H. Fortsetzung der experimentellen Untersuchungen über Alloiophyllie und Viruskrankheiten. Phytopath. Zeitschr. 4: 1-36. 1931.

Klebahn, H. Versuche über das Wesen des Virus der Mosaikkrankheit des Tabaks und über einige andere Viruskrankheiten. Phytopath. Zeitschr. 9: 357-370. 1936.

Lindemuth, H. Impfversuche mit buntblättrigen Malvaceen. Verh. bot. Verein. Brandenburg 14: 32-37. 1872.

_____ Studien über die sogenannte Panaschüre und über einige begleitende Erscheinungen. Landw. Jahrb. 36: 807-862. 1907.

_____ Vorläufige Mitteilungen über weitere Untersuche an Malvaceen Arten. Gartenflora 51: 323-326. 1902.

Morren, E. Contagion de la panachure (Variegatio). Acad. Roy. Belgique. Bull. II, 28: 434-442. 1869.

Smith, K. M. A textbook of plant virus diseases. London. 1937. p. 599.

Soriano, S. Nota sobre algunas enfermedades de los vegetales producidas por 'virus' en la República Argentina. Physis (Rev. Soc. Argentina Cien. Nat.) 11 (38): 87-90. 1932. (RAM 13: 317).

(ACER) MAPLE-VARIEGATION VIRUS

Name:

Synonyms: Maple-mosaic (virus) Atanasoff

Common name: Maple-variegation virus

Geographic distribution: Bulgaria, England, France, Germany, Japan.

Host range: ACERACEAE--Acer negundo L., A. pseudoplatanus L., A. rufinerve Sieb. & Zucc.

Symptoms: Yellow variegation.

Methods of transmission: By budding (Syme) or grafting (Carrière).

Properties: Not determined.

Literature:

Atanasoff, D. Old and new virus diseases of trees and shrubs. Phytopath. Zeitschr. 8: 197-223. 1935.

Carrière, E. A. Influence du greffon sur le sujet. Revue Horticole 59: 58-59. 1887.

Hino, I. List of plants susceptible to mosaic and mosaic-like diseases. Bull. Miyazaki Coll. Agric. & For. No. 5: 97-111. 1933.

Syme, G. The influence of the bud on the stock. Gard. Chron. n.s. 8: 246. 1877

(AESCULUS) HORSECHESTNUT-VARIEGATION VIRUS

Name:

Synonyms:

Common name: Horsechestnut-variegation virus

Geographic distribution: (?) Czechoslovakia, England, Germany.

Host range: HIPPOCASTANACEAE--Aesculus hippocastanum L.

Symptoms: Yellow-leaf variegation (House 1873, Timpe 1907). Mosaic (Blattný 1938).

Methods of transmission: By budding (House 1873). By grafting (Timpe 1907).

Properties: Not determined.

Remarks:

Both House and Timpe report transmission of variegation to green stocks, symptoms appearing in the following season. Timpe reports transmission of vein-banding symptoms from scion to stock, and from stock to scion, but nevertheless interprets these effects as nutritional.

Literature:

Blattný, C. Poznámka o méně známých virových chorobách. Ochrana Rostlin 14 (55): 86-87. 1938. (RAM 17: 543).

House, H. Transfer of variegation from scion to stock. Gard. Chron. 1873: 849. 1873.

Timpe, K. Panaschierung und Transplantation. Jahrb. Hamburg. Wiss. Anstalt 24: 55-104. 1907.

ANEMONE-ALLOIOPHYLLY VIRUS

Name: Anemone virus 1 (Klebahn) Smith 1937
Galla anemones Holmes 1939

Synonyms: Anemone alloiophyllie virus Klebahn 1926

Common name: Anemone-alloiophylly virus

Geographic distribution: Germany.

Host range: RANUNCULACEAE--Anemone nemorosa L., A. ranunculoides L., A. trifolia L. (Klebahn 1928)

Symptoms: Initial symptoms marked hypertrophy of young buds, with the general aspect of a gall, the rhizome remaining unaffected (Klebahn 1926). General hypertrophy of aboveground parts. Leaves pale, with broadened lobes overlapping each other, wrinkled especially at

the margins with upward rolling of the margins common. Flowers rarely produced, deformed, the sepals and carpels hypertrophied, stamens few, pollen lacking (Klebahn 1897), apparently always sterile (Klebahn 1928).

Methods of transmission: By sap (Klebahn 1926). By sap after filtration (Klebahn 1931, 1936). By soil (Klebahn 1926, 1936). No vector known. Symptoms in the season following inoculation.

Properties: Passes collodion filter (Klebahn 1928, 1931, 1936). Precipitated by alcohol from glycerin suspension (Klebahn 1931). Dried leaves are infectious (Klebahn 1936).

Remarks:

The disease occurs sporadically in the wild Anemone nemorosa, chiefly in North Germany. Infected plants are often larger than normal, conspicuous for their pale green color, lack of bloom, or late and long-persisting flowers. Infected and normal shoots may arise from the same rhizome. Diseased rhizomes usually, but not always, develop the disease when grown in a second season.

Literature:

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 108

Klebahn, H. Ueber eine krankhafte Veränderung der Anemone nemorosa L. und über einen in den Drüsenhaaren derselben lebenden Pilz. Bericht. d. Deutsch. Bot. Gesellsch. 15: 527-536. 1897.

_____ Die Alloiophyllie der Anemone nemorosa und ihre vermutliche Ursache. Planta, Arch. Wissensch. Bot., Abt. E, 1: 419-440. 1926.

_____ Experimentelle und cytologische Untersuchungen im Anschluss an Alloiophyllie und Viruskrankheiten. Planta, Arch. Wissensch. Bot. 6: 40-95. 1928.

_____ Fortsetzung der experimentellen Untersuchungen über Alloiophyllie und Viruskrankheiten. Phytopath. Zeitschr. 4: 1-36. 1931.

_____ Versuche über das Wesen des Virus der Mosaikkrankheit des Tabaks und über einige andere Viruskrankheiten. Phytopath. Zeitschr. 9: 357-370. 1936.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 6.

Ulbrich, E. Ein neuer Fall von 'Alloiophyllie' bei Anemone nemorosa L. Verh. bot. Ver. Brandenburg 77: 86-89. 1937.

ANTHURIUM-MOSAIC VIRUS

Name:

Synonyms:

Common name: Anthurium-mosaic virus

Geographic distribution: Belgium

Host range: ARACEAE--Anthurium andraeanum Lind., A. scherzerianum Schott, Monstera deliciosa Liebm., Philodendron corsinianum Makoy, Zantedeschia aethiopica (L.) Spreng. (Z. africana Kunth). SOLANACEAE--Datura stramonium L.

Symptoms: In leaves of Anthurium scherzerianum, systemic grayish-white necrotic spots or lines, curling, malformation; also pale yellow chlorotic lines or spotting; in leaves of Monstera deliciosa, Philodendron corsinianum, and Zantedeschia aethiopica, very fine pale undulating furrows; in Datura stramonium scattered angular yellow spots (after 26 days).

Methods of transmission: By sap.

Properties: Not determined.

Remarks:

Experimental infection in Anthurium scherzerianum, Monstera, Philodendron, Zantedeschia, and Datura, not in Arum italicum, Nicotiana tabacum, or Physalis alkekengi.

Literature:

Verplancke, G. Une maladie à virus filtrant des Anthurium. Comptes rendus Soc. de Biol. 103 (7): 524-526. 1930.

ATROPA-MOSAIC VIRUS

Name:

Synonyms: Belladonna virus K. M. Smith 1943

Common name: Atropa-mosaic virus

Geographic distribution: England.

Host range: LEGUMINOSAE--Phaseolus vulgaris L. SOLANACEAE--Atropa belladonna L., Datura stramonium L., Hyoscyamus niger L., Nicotiana glutinosa L., N. tabacum L., Solanum nigrum L.

Symptoms; In Atropa belladonna, patchy leaf mottling with necrotic spotting under greenhouse conditions; severe leaf and stem necrosis

out of doors. In Nicotiana glutinosa and N. tabacum, primary lesions followed by systemic necrosis. In Phaseolus vulgaris var. Canadian Wonder, primary lesions only.

Methods of transmission: By sap.

Properties: Thermal inactivation point 75–80°C. Infectious at dilution 1:1000, not at 1:10,000. Withstands aging in expressed sap 6 days, not 11 days.

Remarks:
Not transmitted by Myzus persicae Sulz. nor by Thrips tabaci Lind.; the virus is thought not to be insect-borne.

Literature:
Smith, K. M. A virus disease of Atropa belladonna. Parasitology 35 (3): 159–160. illus. 1943

BOLTONIA-STREAK VIRUS

Name:

Synonyms:

Common name: Boltonia-streak virus.

Geographic distribution: Canada (New Brunswick).

Host range: COMPOSITAE—Boltonia sp.

Symptoms: Clearing of veins, followed by vein necrosis and collapse of leaves, streaking of leaves and stems.

Methods of transmission: By grafting. Not by sap.

Properties: Not determined.

Literature:
D. J. McLeod. In Conners, I. J. Twenty-first Ann. Rept. Canadian Plant Disease Survey, 1941. xviii + 102 pp., 1942. p. 88.

(CALLISTEPHUS) ASTER-YELLOWS VIRUS

Names: Callistephus virus 1 (Kunkel) Smith 1937
Chlorogenus callistephi var. vulgaris Holmes 1939

Synonyms: Lettuce Rio Grande disease virus R. E. Smith 1902
Aster yellows virus Kunkel 1924
Lettuce white-heart virus Kunkel 1926
Lettuce rabbit-ear virus Kunkel 1926
Erigeron-yellows virus McClintock 1931

New York aster-yellows virus Kunkel 1932
New York aster-yellows virus Severin 1934a
Gelbsucht der Sommerastern virus Richter 1936
Salsify yellows virus Holmes 1939
Lettuce and endive yellows virus Linn 1940
Potato purple-top wilt virus Younkin 1943

Common name: Aster-yellows virus.

Geographic distribution: United States (replaced by California aster yellows in Pacific and Mountain States (Severin 1934a)), Canada (Conners 1942), Bermuda (Ogilvie 1927), Hungary (Severin 1934b), Germany (Richter 1936), Japan (Fukushi 1930).

Host range:

ACANTHACEAE--Thunbergia alata Bojer.
AIZOACEAE--Tetragonia expansa Murr.
AMARANTHACEAE--Amaranthus auroro, A. caudatus L.
APOCYNACEAE--Vinca rosea L.
ASCLEPIADACEAE--Asclepias nivea L.
BEGONIACEAE--Begonia semperflorens Link & Otto
BORAGINACEAE--Anchusa barrelieri Vitm., A. capensis Thunb., Myosotis scorpioides L.
CAMPANULACEAE--Lobelia erinus L.
CARYOPHYLLACEAE--Dianthus alpinus L., Gypsophila paniculata L., Herniaria glabra L., Lychnis coronaria (L.) Desr., L. viscaria L., Polycarpon tetraphyllum L., Silene pendula L., Tunica saxifraga (L.) Scop., Vaccaria parviflora Moench (V. segetalis (Neck.) Garcke).
CHENOPODIACEAE--Monolepis nuttalliana (Schult.) Greene (M. chenopodioides (Nutt.) Moq.), Spinacia oleracea L.
CISTACEAE--Helianthemum chamaecistus Mill.
COMPOSITAE--Acroclinum roseum Hook., Agoseris glauca (Nutt.) D. Dietr. (Troximon glaucum Nutt.) (Palm 1933), Ambrosia artemisiifolia L., A. trifida L., Ammobium alatum R.Br., Anthemis tinctoria L., Arctotis grandis Thunb., Bellis perennis L., Brachycome iberidifolia Benth., Cacalia hastata L., Calendula officinalis L., Callistephus chinensis (L.) Nees, Carthamus tinctorius L., Centaurea imperialis Hort., C. margaritae Hort., Charieis heterophylla Cass., Chrysanthemum cinerariaefolium (Trev.) Vis., C. coronarium L., C. frutescens L., C. leucanthemum L., C. leucanthemum maximum, C. maximum Ramond, C. parthenium (L.) Bernh. (Feverfew), C. sp. (Little Gem), C. sp. (Pyrethrum sp.), Cichorium endivia L. (Linn 1940), Cineraria hybrida Hort., Cirsium oleraceum (L.) Scop., Cladanthus arabicus (L.) Cass., Coreopsis lanceolata L., C. stillmanii (A. Gray) Blake (Leptosyne stillmani Gray), Coreopsis sp. (Calliopsis), Cosmos bipinnatus Cav., Cousinia hystrix C. A. Mey., Dimorphotheca aurantiaca DC., Echinops dahuricus Fisch., Emilia flammea Cass., Erigeron annuus (L.) Pers., E. canadensis L., E. glabellus Nutt., E. linifolius Willd., E. speciosus (Lindl.) DC., Ethulia conyzoides L., Eupatorium rugosum Houtt. (E. urticaefolium Reich.), E. perfoliatum L., Felicia aethiopica (Burm.) O. Hoffm., F. amelloides (L.) Voss., Filago germanica L., Flaveria trinervia (Spreng.) C. Mohr (F. repanda Lag.), Gaillardia aristata Pursh, Galinsoga parviflora Cav.,

Grindelia squarrosa (Pursh) Dun., Hedypnois cretica (L.) Willd., Helenium autumnale L., H. bigelovii Gray, H. hoopesii Gray, H. nudiflorum Nutt., Helichrysum arenarium (L.) DC., Heliopsis laevis (L.) Pers., Helipterum manglesii F. Muell., Hieracium alpinum L., H. floribundum Wimm. & Grab. (Conners 1942), Koelpinia linearis Pall., Lactuca sativa L., Lagascaea mollis Cav., Leontodon autumnalis L., Leontopodium alpinum Cass., Lindheimeria texana Gray & Engelm., Lonas inodora (L.) Gaertn., Matricaria alba, Mulgedium alpinum (L.) Less., Parthenium integrifolium L., Petasites albus (L.) Gaertn., Rudbeckia hirta L., Sanvitalia procumbens Lam., Schkuria abrotanoides Roth, Scolymus hispanicus L., Sonchus arvensis L., S. oleraceus L., Spilanthes acmella (L.) Murr., Tagetes erecta L., Taraxacum officinale Weber, Thelesperma burridgeanum (Regel) Blake (T. hybridum Voss; Cosmidium), Tolpis barbata (L.) Gaertn., Tragopogon floccosus W. & K., T. porrifolius L., Tridax trilobata (Cav.) Hemsl., Ursinia arthemoides (L.) Benth. & Hook., Zacyntha verrucosa Gaertn., Zinnia multiflora L.

CRUCIFERAE--Alyssum maritimum var. procumbens Hort. (A. compactum procumbens), Cheiranthus allionii Hort., Malcomia maritima (L.) R.Br., Rorippa hispida (Desv.) Britton (Radicula palustris var. hispida (Desv.) Robinson), R. sylvestris (L.) Bess. (Radicula sylvestris (L.) Druce).

DATISCACEAE--Datisca cannabina L.

DIPSACACEAE--Scabiosa atropurpurea L.

GESNERIACEAE--Didymocarpus horsfieldii Schinz., Gloxinia sp.

HYDROPHYLLACEAE--Nemophila sp., Phacelia congesta Hook., P. minor (Harv.) Thell. (P. campanularia A. Gray, P. whitlavia A. Gray), P. viscida Torr.

LABIATAE--Dracocephalum ruyschianum L., Lavandula sp. (Lavender), Physostegia virginiana (L.) Benth., Satureia hortensis L.

LILIACEAE--Allium cepa L. (Brierley & Smith 1944).

LIMNANTHACEAE--Limnanthes douglasii R.Br.

LOASACEAE--Blumenbachia hieronymi Urb., Cajophora lateritia (Hook.) Kl.

MARTYNIACEAE--Martynia sp.

MORACEAE--Humulus japonicus Sieb. & Zucc.

NYCTAGINACEAE--Abronia umbellata Lam.

ONAGRACEAE--Clarkia elegans Dougl.

PAPAVERACEAE--Eschscholzia californica Cham., Papaver nudicaule L.

PLANTAGINACEAE--Plantago alpina L., P. fuscescens Jord., P. major L., P. psyllium L.

PLUMBAGINACEAE--Armeria alpina Willd., Limonium suworowi (Regel) Kuntze

POLEMONIACEAE--Gilia densiflora Benth., G. tricolor Benth., Phlox drummondii Hook., P. paniculata L., Polemonium caeruleum L.

POLYGONACEAE--Fagopyrum esculentum Moench

PORTULACACEAE--Calandrinia grandiflora Lindl., Portulaca sp.

PRIMULACEAE--Anagallis linifolia L., Primula elatior Hill.

RANUNCULACEAE--Adonis aestivalis L.

RESEDACEAE--Reseda odorata L.

ROSACEAE--Potentilla monspeliensis L.

SCROPHULARIACEAE--Alonsoa warscewiczi Regel, Calceolaria sp., Collinsia bicolor Benth., Linaria cymbalaria (L.) Mill., L. maroccana Hook., Maurandia lophospermum Bailey, M. scandens (Cav.) Pers.,

Mimulus luteus L., Nemesia sp., Verbascum hybridum Hort., Veronica peregrina L.

SOLANACEAE--Browallia demissa L., Hyoscyamus niger L., Lycopersicon esculentum Mill. (Solanum lycopersicum L.), Nicotiana rustica L., Petunia hybrida Vilm., Salpiglossis sp., Schizanthus sp., Solanum tuberosum L. (Younkin 1943).

UMBELLIFERAE--Ammi majus L., Anethum graveolens L., Daucus carota L., Didiscus caeruleus DC., D. pusillus F. & M., Levisticum paludapifolium (Lam.) Aschers., Pastinaca sativa L., Pimpinella anisum L.

VALERIANACEAE--Centranthus calcitrapa (L.) Dufr.

(Kunkel 1926, 1931 except as noted).

Symptoms: Erect habit and abnormal stimulation of lateral branching. In some hosts general chlorosis without mottling. Clearing of veins in young leaves, virescence of flowers and sterility. Symptoms after about 10 days.

In China aster, diseased ovaries are elongated and thickened, ovules elongated and shriveled, and pappus hairs are modified to bract-like scales. In marguerite (Chrysanthemum frutescens) the pistils elongate and bear secondary flower buds (Smith 1902). In Agoseris glauca the pollen is normal in yellowed plants but the ovules are abnormal. The development of sporogenous cells is delayed or lacking, the funiculus elongated and flattened, the integument is deficient or undifferentiated, and anatropous growth is retarded. The female gametophyte degenerates at the 2-nucleate stage. (Palm 1933.)

Methods of transmission: By grafting and budding (Kunkel 1926). By dodder (Johnson 1941). By Macrosteles divisus (Uhl.) (formerly known as Cicadula sexnotata (Fall.), C. divisa (Uhl.)) (Kunkel 1924). Not by sap from aster to aster (Kunkel 1926, 1931, Rawlins and Tompkins 1936) but transmissible by juice from viruliferous to non-viruliferous hoppers (Black 1940). Not through seeds (Kunkel 1926, McClintock 1931). Not through eggs of the vector (Kunkel 1926).

Properties: Active in extracted juice of viruliferous Macrosteles divisus at dilutions up to 1:1000. Largely destroyed by freezing for 20 minutes at -10°C (Black 1941). Withstands aging 24 but not 48 hours at 0°C, 2 but not 3 hours at 25°C, 10 minutes at 35°C. Passes Berkefeld N and V filters that retain Serratia marcescens. Precipitated by centrifuging 1 minute at 500 r.p.m. (Black 1943). Inactivated in living M. divisus at 32°C in 12 days, or at 42°C in 1 day (Kunkel 1937, 1941); in living Vinca rosea L. at 42°C in 14 days or at 38°C in 14 days (Kunkel 1941).

Remarks:

Macrosteles divisus acquires the virus in 24 hours, not in 2 hours, of feeding on the source plant (Kunkel 1926). Hoppers become infective after an incubation period of 10 days or more (Kunkel 1926). Many individuals of M. divisus retain the virus for life (some over 100 days); some appear to lose it after a short time (Kunkel 1926).

No visible evidence of the virus is found in the vector Macrosteles divisus (Kunkel 1926, Dobroscky 1929). By mechanical inoculation from

viruliferous to non-viruliferous M. divisus Black (1941) has shown that the virus is present in the vector, that it undergoes an incubation period of 11 to 45 days in inoculated hoppers, and that it multiplies at least 100-fold in the vector during this incubation period. Inoculated hoppers usually retain the virus for life. The virus reaches a high concentration in inoculated M. divisus 6 days before the hoppers are able to transmit it to asters (Black 1941).

California-aster-yellows virus is distinguished from the type strain by additional host and vector species (Kunkel 1932, Severin 1934a). A heat-attenuated strain (Chlorogenus callistephi var. attenuatus Holmes) experimentally produced by Kunkel (1937) is distinguished from the type strain by milder symptom expression in asters. Potato purple-top wilt virus differs from the type strain of aster-yellows virus in symptom expression in Nicotiana rustica (Younkin 1943).

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Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 23.

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Palm, B. T. The gametophytes in a composite affected with "aster-yellows." Svensk Bot. Tidskr. 27: 420-437. 1933.
Rawlins, T. E., and Tompkins, G. M. Studies on the effect of carborundum as an abrasive in plant virus inoculations. Phytopath. 26: 578-587. 1936.
Richter, H. Die Gelbsucht der Sommerastern. Nachrichtenbl. Deutsch. Pflanzenschutzd. 16: 66-67. 1936.
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_____ Transmission of California aster and celery yellows virus by three species of leafhoppers. Hilgardia 8: 339-361. 1934 (b)
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_____ Purple-top wilt of potatoes caused by the aster yellows virus. Amer. Potato Jour. 20: 177-183. 1943.

(CALLISTEPHUS) CALIFORNIA-ASTER-YELLOWS VIRUS

Names: Callistephus virus 1A (Severin) Smith 1937
Chlorogenus callistephis var. californicus Holmes 1939

Synonyms: Celery yellows virus Severin 1929
Delphinium witches' broom virus (?) Hungerford 1933
California aster yellows virus Severin 1934a
Delphinium stunt virus (in part) Burnett 1934
Delphinium aster yellows virus Severin and Oliver 1939

Common name: California-aster-yellows virus

Geographic distribution: United States--California, Colorado, Oregon, Utah, Washington, Wyoming (Severin 1934, 1942a)

Host range: CHENOPODIACEAE--Spinacia oleracea L. COMPOSITAE--Callistephus chinensis (L.) Nees, Chrysanthemum segetum L., Helichrysum bracteatum Andr., Lactuca sativa L., Sonchus asper (L.) Hill (Severin 1942a), Tagetes erecta L., T. patula L. Tragopogon porrifolius L., Zinnia elegans Jacq., Z. haageana Regel. CRUCIFERAE--Brassica alba (L.) Boiss. LILIACEAE--Allium cepa L. (KenKnight 1943). MALVACEAE--Malva parviflora L. (Severin 1942a). ONAGRACEAE--Godetia grandiflora Lindl. PAPAVERACEAE--Eschscholzia californica Cham. PLANTAGINACEAE--Plantago major L. POLYGONACEAE--Fagopyrum esculentum Moench. RANUNCULACEAE--Delphinium ajacis L. (Severin 1942a,c), D. cultorum Voss (?) (perennial delphinium, Severin

1942a), Ranunculus asiaticus L. SOLANACEAE--Nicotiana rustica L., Solanum tuberosum L. (Severin & Haasis 1943, Severin 1940). UMBELLIFERAE--Anethum graveolens L., Apium graveolens L. and vars. dulce and rapaceum, Daucus carota L. var. sativa, Pastinaca sativa L., Petroselinum crispum (Mill.) Nym. (P. hortense Hoffm.) and vars. crispum and radicosum.

Apium graveolens, Zinnia elegans, Solanum tuberosum, and Brassica alba, as well as species susceptible to the virus of typical aster yellows so far as tested (Holmes 1939). It has been reported subsequently (Younkin 1943) that S. tuberosum is susceptible to typical aster yellows as well.

Symptoms: In celery, the outer petioles first upright and somewhat elongated, the inner petioles short, chlorotic, twisted, brittle, and often cracked. General yellowing (Severin 1929). In zinnia, chlorosis, stunting, abnormal flowers (Severin 1929). In potato, purple, sessile aerial tubers, with purple, dwarfed leaves developing from these tubers (Severin 1940). In delphinium, dwarfing, yellowing, proliferation of laterals, virescence of flowers, phyllody of carpels and stamens (Severin 1942a). In China aster and most other hosts, symptoms as for the type strain.

Methods of transmission: By Macrosteles divisus (Uhl.) (formerly called Cicadula sexnotata (Fall.) and C. divisa Uhl.) (Severin 1934a, 1942a). By both short- and long-winged races of this leafhopper (Severin 1940, 1942a). By Thamnotettix geminatus Van D. and T. montanus Van D. (Severin 1934b). Not by sap (Severin 1929, 1942a). Not through seed (Burnett 1934). Symptoms after 11 to 27 days in China aster, after 18 to 79 days in celery (Severin 1929), after 15 to 106 days in delphinium (Severin 1942a).

Properties: The virus requires an incubation period of 17 to 26 days in the vector Macrosteles divisus (Kunkel 1932). It is not carried in the eggs of the vectors Thamnotettix geminatus and T. montanus (Severin 1934b). It is rarely transmitted by M. divisus from solutions containing crushed infective individuals of this species (Severin 1934a).

Remarks:

Thamnotettix montanus and T. geminatus transmit the virus with low efficiency to aster, and with somewhat higher efficiency to celery (Severin 1934b, 1942a). T. montanus failed to transmit the type strain from New York and Wisconsin collections of aster to aster or celery (Severin 1943a).

Perennial delphiniums are unfavorable food plants for Macrosteles divisus, but favored breeding plants for Thamnotettix geminatus and T. montanus. The two last named are therefore the most important vectors of this virus in delphiniums. The geographic distribution of California aster yellows corresponds well with that of T. geminatus and T. montanus (Severin 1942a).

Delphinium-stunt virus (Burnett 1934) is not synonymous with aster-yellows virus, but the greening and malformation of the inflorescence and dwarfing that Burnett described but failed to transmit by sap are

considered symptoms of California aster yellows (Severin 1942a,b), while Burnett's sap-transmitted virus may have been celery-calico virus which is often associated with California-aster-yellows virus in delphiniums in nature (Severin 1942b).

Aster-yellows virus in samples of delphinium, carrot, and celery from Idaho did not prove identical with the California-aster-yellows virus (Severin 1934a, 1942a). Consequently Hungerford's (1933) delphinium witches'broom, and KenKnight's (1943) onion-yellows are only tentatively attributed to this strain.

Literature:

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Heald, F. G., and Burnett, G. A virous disease of perennial delphiniums. Bull. Amer. Delphinium Soc. 2 (2): 14-21. 1934

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 3-4

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KenKnight, Glenn. The aster yellows disease of vegetable seed crops in Idaho. Univ. Idaho, Dept. Pl. Path. Mimeo-leaflet 79. 3 pp. 1943

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Severin, H. H. P. Yellows disease of celery, lettuce, and other plants, transmitted by Cicadula sexnotata (Fall.). Hilgardia 3: 543-583. 1929.

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_____ Transmission of carrot, parsley, and parsnip yellows by Cicadula divisa Uhl. Hilgardia 7: 163-179. 1932

_____ Experiments with the aster yellows virus from several states. Hilgardia 8: 305-325. 1934 (a).

_____ Transmission of California aster and celery yellows by three species of leafhoppers. Hilgardia 8: 339-361. 1934 (b).

_____ Potato naturally affected with California aster yellows. Phytopath. 30: 1049-1051. 1940.

_____ Infection of perennial delphiniums by California aster-yellows virus. Hilgardia 14: 411-440. 1942 (a).

_____ Celery calico on perennial delphiniums and certain other host plants. Hilgardia 14: 443-464. 1942 (b).

_____ Viroses of annual larkspurs. Hilgardia 14: 585-594. 1942 (c).

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_____, and Haasis, F. A. Transmission of California aster yellows to potato by Cicadula divisa. Hilgardia 8: 329-335. 1934

Severin, H. H. P, and Oliver, S. J. Delphinium aster yellows. Phytopath. 29: 826. 1939 (Abst.).
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Younkin, S. G. Purple-top wilt of potatoes caused by aster yellows virus. Phytopath. 33: 16. 1943 (Abst.).

CAMELLIA-YELLOW-SPOT VIRUS

Name:

Synonyms:

Common name: Camellia-yellow-spot virus. Milbrath & McWhorter 1940.

Geographic distribution: Oregon.

Host range: TERNSTROEMIACEAE--*Camellia* sp.

Symptoms: In leaves, yellowing, mottling, epidermal roughening or corkiness, occasionally necrosis.

Methods of transmission: By grafting.

Properties: Not determined.

Literature:
Milbrath, J. A., and McWhorter, F. P. Camellia yellow spot - a virus disease. Phytopath. 30: 788. 1940. (Abst.).

CANNA-MOSAIC VIRUS

Name:

Synonyms: Canna indica mosaic virus Ocfemia & Macaspac 1941.

Common name: Canna-mosaic virus.

Geographic distribution: Japan (Fukushi 1932), Philippines (Ocfemia 1937).

Host range: CANNACEAE--*Canna edulis* Ker, *C. indica* L., *Canna* spp. (ornamental varieties). MUSACEAE--*Musa textilis* Née.

Symptoms: In *Canna indica*, irregular pale yellow streaks parallel with lateral veins of leaves, later often rusty brown, with more or less wrinkling, curling, and premature drying. Yellowish bands on stems, sepals, and petals. Mottling of fruits. Initial symptoms after 2 weeks. In ornamental cannas, rusty brown streaks in leaves, and orange streaks in petals. In *Musa textilis*, greenish-yellow, later yellowish-orange streaks in leaves, parallel with the lateral veins (Ocfemia and Macaspac 1941.)

Methods of transmission: By sap with difficulty (?) (one infection). By Aphis gossypii Glover, and A. maidis Fitch. Not by A. laburni Kalt., Pentalonia nigronervosa Coq., or Rhopalosiphum nymphaeae L. Not through seed of Canna indica (Ocfemia & Macaspac 1941.)

Properties: Not determined.

Remarks:

Canna-mosaic virus appears distinct from abacá-mosaic virus (=cucumber-mosaic virus, Celino 1940) although both produce somewhat similar symptoms in Canna indica and Musa textilis. Canna-mosaic virus is transmissible to C. edulis and ornamental canna varieties by Aphis gossypii (Ocfemia & Macaspac 1941), but abacá-mosaic virus is not transmitted to these plants by its vector Rhopalosiphum nymphaeae (Celino 1940). R. nymphaeae failed to transmit canna-mosaic virus (Ocfemia & Macaspac 1941).

Canna-mosaic virus was not transmitted to cucumber by Aphis gossypii (Ocfemia & Macaspac 1941.)

Aphis gossypii transmits canna-mosaic virus in the non-persistent manner, acquiring the virus in 5 minutes' feeding on a source plant, and becoming noninfective after feeding on one healthy plant or after 1 hour in a test tube without food (Ocfemia & Macaspac 1941).

Literature:

Celino, M. S. Experimental transmission of the mosaic of abacá, or Manila hemp plant (Musa textilis Née). Philipp. Agric. 29: 379-414. 1940.

Fukushi, T. A contribution to our knowledge of virus diseases of plants in Japan. Trans. Sapporo Nat. Hist. Soc. 12: 130-141. 1932.

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_____, and Macaspac, I. S. Experimental transmission of the mosaic of Canna indica. Philipp. Agric. 30: 357-370. 1941.

CEPHALANTHUS-MOSAIC VIRUS

Name:

Synonyms:

Common name: Cephalanthus-mosaic virus.

Geographic distribution: United States (Missouri).

Host range: RUBIACEAE—Cephalanthus occidentalis L.

Symptoms: Small pale spots in young leaves, enlarging and coalescing to form conspicuous large irregular yellow patches in older leaves; pale green spots on petioles and young twigs also. Little change

in anatomy or cytology of diseased leaves until late stages, when chloroplasts degenerate and large starch grains appear.

Methods of transmission: By sap, (Symptoms after 7 to 16 days).

Properties: The virus is killed at 100°C, not at 60°C (time not specified). Infectious in dried herbarium material 1 to 2 weeks old. Sap diffused through an unspecified membrane was infectious.

Remarks:
Extracts from diseased leaves, petioles, shoots, and roots were all infectious. Inoculations from root to root, and thence to leaves, succeeded; this suggested to Uphof that natural spread is through roots. Inoculations of other plant species associated with Cephalanthus in the wild were negative.

Literature:
Uphof, J. C. T. Eine neue Krankheit von Cephalanthus occidentalis. Zeitschr. Pflanzenkr. 31: 100–108. 1921.

CONVALLARIA-MOSAIC VIRUS

Name:

Synonyms:

Common name: Convallaria-mosaic virus. Blattný 1929.

Geographic distribution: Czechoslovakia.

Host range: LILIACEAE—Convallaria majalis L.

Symptoms: Mosaic mottling.

Methods of transmission: By sap inoculation of underground parts. By cutting with a knife contaminated with the virus. No vector is established.

Properties: Not determined.

Literature:
Blattný, C. Mosaika konvalinky (Convallaria majalis L.). Ochrana Rostlin 9: 19–21. 1929 (RAM 8: 589. 1929).

DAHLIA-MOSAIC VIRUS

Name: Dahlia virus 1 (Brandenburg) Smith 1937
Marmor dahliae Holmes 1939

Synonyms: Dahlia mosaic and yellows (virus) Howe 1922
Dahlia stunt or dwarf (virus) Howe 1923
Dahlia leaf-curl and rosette virus Martin 1929

Common name: Dahlia-mosaic virus.

Geographic distribution: Widespread. Belgium, England, Germany, Holland, United States, Canada, Argentine, Brazil, Australia.

Host range: COMPOSITAE—Dahlia imperialis Roezl, D. maxonii Safford, D. variabilis Desf.

Symptoms: In leaves, chlorotic vein-banding. Rosetting in some varieties.

Methods of transmission: By grafting (Brandenburg 1928). Not by sap. By Myzus persicae Sulz. (Brierley 1933).

Properties: Not determined.

Remarks:

Dahlia mosaic is typically a vein-mosaic, with narrow to broad yellowish bands associated with the midribs or branch veins. Dahlia ringspot, yellow-ringspot, and oakleaf (Brierley 1933), characterized by chlorotic or necrotic rings or furrows, are not treated here because of the strong probability that they represent forms of tomato spotted-wilt, caused by Lycopersicum Virus 3 (Brittlebank) Smith 1937; Lethum australiense Holmes 1939 (Smith 1937, McWhorter 1941, and unpublished evidence from various sources).

Streak, characterized by black necrotic streaks in stems, petioles, and flower stalks, and by brown necrotic lesions in storage roots, is described as a separate virus disease by Campbell (1933, 1934), and is reported by Schneiders (1937), but no evidence of experimental transmission is reported.

Literature:

Berkeley, G. H. Dahlia mosaic and its control. Canad. Hort. (Floral ed.) 61: 146-147. 1938.

Brandenburg, E. V. Ueber Mosaikkrankheiten an Compositen. Forsch. Gebiet Pflanzenkr. u. Immunität. Pflanzenr. 5: 39-72. 1928.

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Campbell, A. H. A serious disease of dahlias. The Dahlia Year Book 1933, pp. 13-15. 1933.

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Herbert, D. Plant viruses in Queensland I. Pap. Dep. Biol. Univ. Queensland 1, 11. 4pp. 1939.

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 85-86.

Howe, M. A. The leafhopper as an enemy of the dahlia. Bull. Amer. Dahlia Soc. Ser. 3 (22): 18; (23): 18, 26. 1922

Howe, M. A. Dahlias and their culture. Journ. New York Bot. Gard. 24: 169-187. 1923

Marchal, É. Observations et recherches effectués à la Station de Phytopathologie de l'Etat pendant l'année 1933. Bull. Inst. Agron. et des Stat. de Recherches de Gembloux 3: 97-106. 1934. (RAM 13: 492).

Marchionatto, J. B. Las enfermedades de las Dalias. Bol. Agríc. Mendoza 8: 337-341. 1940.

McWhorter, F. P. Certain ornamentals may carry virus diseases to truck crops. Oregon St. Hort. Soc. Ann. Rept. 1941: 47-50. 1941.

Müller, A. S. Brazil: preliminary list of diseases of ornamental plants in the State of Minas Geraes. Int. Bul. Plant Protect. 9 (5): 104-105. 1935 (RAM 14: 634).

Schneiders, E. Über Abbau und Viruskrankheiten der Kulturpflanzen unter besonderer Berücksichtigung der Viruskrankheiten an Dahlien. Gartenflora 86: 199-202. 1937.

Smith, K. M. A textbook of plant virus diseases. London 1937, pp. 208-212.

DAPHNE-MOSAIC VIRUS

Name:

Synonyms:

Common name: Daphne-mosaic virus

Geographic distribution: New Zealand.

Host range: THYMELAEACEAE—*Daphne odora* Thunb.

Symptoms: Pale yellowish spotting, typically close-spaced and forming an even mosaic pattern, also large irregular yellowish patches with a tendency to follow the veins, and occasional distortion of the leaf lamina.

Methods of transmission: By sap (with difficulty). By grafting.

Properties: Not determined.

Remarks:

Symptomless shoots appear on diseased plants; the virus is usually not present in such shoots.

Literature:

Chamberlain, E. E., and Matthews, R. E. F. A virus disease of cultivated Daphne. New Zealand Jour. Science & Techn. 23: 254A-256A. 1941.

DATURA-MOSAIC VIRUS

Name:

Synonyms:

Common name: Datura-mosaic virus

Geographic distribution: India

Host range: SOLANACEAE--Datura fastuosa L., Nicotiana glutinosa L., Petunia hybrida Vilm.

Symptoms: In Datura fastuosa, green mottling in leaves; in Nicotiana glutinosa, local lesions; in Petunia hybrida, transitory leaf mottling.

Methods of transmission: By sap.

Properties: Not determined.

Literature:

Rep. Imp. Counc. Agric. Res., New Delhi, 1940-41, p. 36, 1942. (RAM 21: 342).

Rep. Imp. Counc. Agric. Res. Delhi, 1941-42, pp. 3-39, 1943. (RAM 22:381).

DATURA-"QUERCINA" VIRUS

Name:

Synonyms:

Common name: Datura-"Quercina" virus

Geographic distribution: England, France, United States.

Host range: SOLANACEAE--Datura meteloides DC., D. stramonium L., Solanum pseudocapsicum L.

Symptoms: In Datura stramonium, indentations in leaf margins, slitting of the corolla, shriveling of stamens with little or no functional pollen, partial or complete suppression of spines on the capsules, general reduction in vigor. In purple flowered varieties the stems and corollas are deeper colored than normal.

Methods of transmission: Not by sap. By grafting. By seeds to 79 percent of the offspring of "Quercina" female parents. By pollen.

Properties: Not determined.

Remarks:
Potato, petunia, pepper are not susceptible. The Z disease described by Blakeslee (1921) is now attributed to a strain of Tobacco-etch virus (Nicotiana virus 7 Smith 1937, Marmor erodens Holmes 1939) by Chester (1937).

Literature:
Blakeslee, A. F. A graft-infectious disease of Datura resembling a vegetative mutation. Journ. Genetics 11: 17-36. 1921.
Chester, K. S. Serological studies of plant viruses. Phytopath. 27: 903-912. 1937.

DATURA-VIROSIS VIRUS

Name: Datura virus 1 Smith and d'Oliveira 1937

Synonyms:

Common name: Datura-virosis virus

Geographic distribution: England

Host range: LEGUMINOSAE--Phaseolus vulgaris L., Vigna sinensis (Torner) Savi. SOLANACEAE--Datura stramonium L., Nicotiana tabacum L., N. glutinosa L., Lycopersicon esculentum Mill.

Symptoms: In Datura stramonium, in rubbed leaves, yellow flecks becoming necrotic and enlarging with age; also systemic yellow flecking. Similar effects in other hosts.

Methods of transmission: By sap. Transmission by Myzus persicae Sulz. suspected but not demonstrated.

Properties: Thermal death point 50-55°C. Dilution end point between 1:5000 and 1:10,000. Infectious in expressed sap after 9 days, not after 12 days, at room temperatures.

Literature:
Smith, K. M. A textbook of plant virus diseases. London 1937. p. 332-335.

DELPHINIUM-RINGSPOT VIRUS

Name:

Synonyms: Delphinium ringspot virus Severin and Dickson 1942

Common name: Delphinium-ringspot virus

Geographic distribution: United States (California).

Host range: CHENOPODIACEAE--Beta vulgaris L. CUCURBITACEAE--Cucumis sativus L. MALVACEAE--Gossypium hirsutum L. RANUNCULACEAE--Delphinium sp. (perennial delphinium), Ranunculus asiaticus L. SOLANACEAE--Datura stramonium L., Nicotiana alata Link & Otto var. grandiflora Comes, N. glutinosa L., N. rustica L. var. humilis Schrank, N. tabacum L., Petunia hybrida Hort. The virus appears to be restricted to perennial delphinium in nature (Severin & Dickson 1942).

Symptoms: "On young leaves of delphinium faint chlorotic rings enclosing green or yellow centers; on mature leaves, irregular chlorotic rings encircling green areas, yellow bands, and irregular chlorotic areas" (Severin & Dickson 1942).

Methods of transmission: By sap. No vector is known. Symptoms after 32 to 42 days in delphinium.

Properties: Thermal inactivation point 60-65°C. Dilution tolerance 1:1000. Tolerates aging at room temperature 4 days, not 5 days.

Remarks:

Severin and Dickson (1942) consider delphinium-ringspot virus distinct from 8 other viruses that Severin (1942,a,b,c) has studied in this species, namely the viruses of California aster yellows, celery calico, tomato spotted wilt, cucumber mosaic, western cucumber mosaic, tobacco ringspot, tobacco mosaic, and curly top. Delphinium-ringspot virus agrees most closely with cucumber-mosaic virus, of which Valleau's (1932) delphinium virus is now considered to be a strain (Chester 1937); but delphinium-ringspot virus failed to infect a number of species that are susceptible to cucumber-mosaic virus, including Spinacia oleracea, Vigna sinensis, Apium graveolens var. dulce, Lycopersicon esculentum, and Capsicum frutescens, and was not transmitted by any of the insects tested, including Aphis gossypii Glover and Myzus persicae (Sulz.) (Severin & Dickson 1942).

Literature:

Chester, K. S. Serological studies of plant viruses. Phytopath. 27: 903-912. 1937.

Severin, H. H. P. Infection of perennial delphiniums by California aster-yellows virus. Hilgardia 14: 411-440. 1942 (a).

_____ Celery calico on perennial delphiniums and certain other host plants. Hilgardia 14: 441-464. 1942 (b).

_____ The susceptibility of perennial delphiniums to six viruses. Hilgardia 14: 549-561. 1942 (c).

_____, and Dickson, R. C. Perennial delphinium ringspot. Hilgardia 14: 465-490. 1942.

Valleau, W. D. A virus disease of delphinium and tobacco. Kentucky Agr. Exp. Sta. Bull. 327: 81-88. 1932.

(DIANTHUS) CARNATION-MOSAIC VIRUS

Name:

Synonyms: Carnation-yellows (virus) Jones 1940
Carnation mosaic virus Creager 1943

Common name: Carnation-mosaic virus

Geographic distribution: England (Smith 1937), Japan (Asuyama 1938, Fukushi 1932), United States

Host range: CARYOPHYLLACEAE—Dianthus caryophyllus L.

Symptoms: Light and dark green mottling in young leaves, later whitish, sunken, elongated streaks, eventually becoming reddish, purplish or brown. Similar streaks in stems. Light-colored streaks and distortion in flowers (Creager 1943). Symptoms are most conspicuous in late fall, winter, and early spring (Creager 1944).

Methods of transmission: By sap (Jones). By grafting (Jones, Creager). By aphids (unspecified)(Jones 1940).

Properties: Not determined

Remarks:
Jones states (1942) that 2 viruses appear to be associated with the disease.

Literature:

Asuyama, H. New diseases and pathogens reported recently on the cultivated plants of Japan IV. Ann. Phytopath. Soc. Japan 7 (3-4): 231-236. 1938. (Japanese) (RAM 17: 506).

Creager, D. B. Carnation mosaic. Phytopath. 33: 823-827. 1943.

_____ How to recognize and control mosaic on carnation plants. Flor. Rev. 93 (2409): 27-29. 1944

Fukushi, T. A contribution to our knowledge of virus diseases of plants in Japan. Trans. Sapporo Nat. Hist. Soc. 12: 130-141. 1932.

Jones, L. K. Carnation yellows. In Fiftieth Annual Report for the fiscal year ended June 30, 1940. Wash. Agric. Exp. Sta. Bull. 394: 76-77. 1940.

_____ Carnation yellows. In Fifty-second Annual Report for the fiscal year ended June 30, 1942. Wash. Agric. Exp. Sta. Bull. 425: 74. 1942.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 554.

EMILIA-VARIEGATION VIRUS

Name:

Synonyms: Emilia disease virus (Loos).

Common name: Emilia-variegation virus

Geographic distribution: Ceylon.

Host range: COMPOSITAE--Emilia scabra DC.

Symptoms: Yellow vein banding.

Methods of transmission: By grafting (Symptoms after 11 to 14 days). Not by sap.

Properties: Not determined.

Remarks:
Attempts to infect tobacco failed. The symptoms of this disease are distinct from those of tomato-spotted-wilt virus in Emilia scabra. This plant is a weed.

Literature:
Loos, C. A. A virus disease of Emilia scabra. Trop. Agriculturist (Ceylon) 97: 18-21. 1941.

EPIPHYLLUM-MOSAIC VIRUS

Name:

Synonyms: Epiphyllum-mosaic virus Blattný & Vukolov 1932

Common name: Epiphyllum-mosaic virus.

Geographic distribution: Czechoslovakia, Germany.

Host range: CACTACEAE--Epiphyllum truncatum Haw. and varieties, E. bridgesii Lem., Pereskia aculeata Mill., Phyllocactus gaertneri (Regel) Schum. var. mackoyanus, Rhipsalis rosea Lagerh.

Symptoms: In Epiphyllum truncatum, early stages show scattered, pale, diffuse-bordered, somewhat sunken spots, best seen by transmitted light; in mid-stages these spots coalesce irregularly to form large whitish-green blotches, thinner than normal; in advanced stages these blotches dry and turn brown, occasionally fall out. Dwarfing, distortion, delayed flowering, premature death characterize severe infections. The epidermis is much thinner than normal, all tissue elements reduced in size, and chloroplasts fewer in diseased tissues. Blattný and Vukolov 1932.

Methods of transmission: By grafting, by sap, by Orthezia insignis Dougl. (Hemiptera-Coccidae). (Blattný and Vukolov 1932)

Properties: Not determined.

Remarks:
Blattný & Vukolov (1932) and Pape (1932) illustrate mosaic symptoms in Epiphyllum. Blattný & Vukolov report experimental infection of 1/30 Epiphyllum truncatum plants by sap, 4/30 by Orthezia insignis, 5/30 by injection of crushed infective Orthezia, 0/30 by injection of dried Epiphyllum stem material, 0/30 in controls, no infection by larvae raised from eggs of infective Orthezia. They showed that Pereskia aculeata, often used as a stock for Epiphyllum, can serve as a symptomless carrier. Pape (1932) reports symptoms in several varieties of Epiphyllum truncatum, and also in E. bridgesii, Phyllocactus gaertneri var. mackoyanus, and Rhipsalis rosea, but records no transmission experiments. Weingart (1920) reports one successful graft transfer from Opuntia monacantha variegata to the green species, white spotting appearing in the stock in the following summer.

Literature:
Blattný, C., and Vukolov, V. Mosaik bei Epiphyllum truncatum. Gartenbauwissenschaft. 6: 425-432. 1932.
Pape, H. Mosaikkrankheit an Glieder-, Blatt- und Rutenkakteen. Gartenwelt 36: 707-708, 731-732. 1932.
Weingart, W. Buntgefleckte-Kakteen. Monatschr. Kakteenk. 30: 145-147. 1920.

EUONYMUS-VARIEGATION VIRUS

Name: Marmor euonymi Holmes 1939. p. 51

Synonyms: Euonymus infectious chlorosis (virus) Baur

Common name: Euonymus-variegation virus

Geographic distribution: Germany, Japan, United States

Host range: CELASTRACEAE--Euonymus japonicus L., E. fortunei var. radicans (Miq.) Rehd. (E. radicans).

Symptoms: Chlorosis appears as pale streaks, continuous or interrupted, along the veins of young leaves. These mask with further growth of the leaf, but pale flecks appear in the mesophyll which persist in fully expanded leaves (Rischkow).

Methods of transmission: By grafting (Bouché, Baur, Davis), and budding. Not by sap (Davis).

Properties: Not determined.

Remarks:
The conspicuous golden variegations in ornamental forms of Euonymus are genetic, but may mask the veinal chlorosis which is infectious. Green and yellow areas are more sharply demarked in the genetic variegations (Rischkow).

Literature:
Baur, E. Über eine infektiöse Chlorose von Evonymus japonicus. Bericht. d. Deutsch. Bot. Gesellsch. 26a: 711-713. 1908.
Bouché, C. Ueber das Buntwerden der Blätter als krankhafte Ansteckung durch Pfropfreiser bei Evonymus japonicus, wie bei Abutilon. Gesellsch. Naturforsch. Freunde Berlin, Sitzungsber. 1871: 66-68. 1871 (Not seen).
Davis, E. F. Some chemical and physiological studies on the nature and transmission of "infectious chlorosis" in variegated plants. Ann. Missouri Bot. Gard. 16: 145-226. 1929.
Fukushi, T. A contribution to our knowledge of virus diseases of plants in Japan. Trans. Sapporo Nat. Hist. Soc. 12: 130-141. 1933.
Holmes, F. O. A handbook of phytopathogenic viruses. Minneapolis 1939. p. 51.
Rischkow, W. Neue Daten über geaderte Panaschierung bei Evonymus japonicus und Evon. radicans. Biol. Zentralbl. 47: 752-764. 1927.

FRAXINUS-VARIEGATION VIRUS

Name:

Synonyms: Fraxinus infectious chlorosis (virus) Baur 1907

Common name: Fraxinus-variegation virus

Geographic distribution: England, Germany, Bulgaria.

Host range: OLEACEAE--Fraxinus americana L., F. excelsior L., F. pennsylvanica Marsh. (F. pubescens Lam.).

Symptoms: Systemic yellow chlorotic leaf spotting.

Methods of transmission: By grafting (Syme, Baur).

Properties: Not determined.

Remarks:
Scions of Fraxinus pennsylvanica var. aucubaefolia (K. Koch) Rehd., an ornamental variety, transferred the virus to green F. pennsylvanica stocks. Earlier records of transfer are cited by Baur 1907, and by Atanasoff 1935.

Literature:
Atanasoff, D. Old and new virus diseases of trees and shrubs. Phytopath. Zeitschr. 8: 197-223. 1935.
Baur, E. Über infektiöse Chlorosen bei Ligustrum, Laburnum, Fraxinus, Sorbus und Ptelea. Bericht. d. Deutsch. Bot. Gesellsch. 25: 410-413. 1907.
Syme, G. The influence of the bud on the stock. Gard. Chron. n. s. 8: 246. 1877.

GLADIOLUS-MOSAIC VIRUS

Name:

Synonyms:

Common name: Gladiolus-mosaic virus.

Geographic distribution: Widespread--Canada, England, Brazil, United States, Venezuela, Japan.

Host range: IRIDACEAE--Gladiolus hybrids.

Symptoms: Systemic chlorotic mottling in leaves; breaking of the flower color.

Methods of transmission: Not by sap. By Myzus circumflexus Buckt., M. persicae Sulz. Not through seed.

Properties: Not determined.

Remarks:
Dosdall (but not Smith and Brierley) noted stunting of affected plants and malformation of corms. Smith and Brierley report similar mosaic viruses in Babiana, Ixia, Sparaxis, Streptanthera, Tigridia, Tritonia, and Watsonia, transmissible by Myzus persicae.

Literature:
Dimock, A. W. The season's No. 1 gladiolus disease--mosaic. Gladiolus (Yearbk. New Engl. Gladiolus Soc.) 16 (1941): 117-123. c1940
Dosdall, Louise. A mosaic disease of gladiolus. Phytopath. 18: 215-217. 1927.
Drayton, F. L. Studies and notes on the diseases of ornamental plants. Rept. Dominion Botanist for the year 1927, Div. of Botany, Canada Dept. of Agric. pp. 15-31. 1928.
Fukushi, T. A contribution to our knowledge of virus diseases of plants. Trans. Sapporo Nat. Hist. Soc. 12: 130-141. 1932.
Müller, A. S. Brazil: preliminary list of diseases of ornamental plants in the State of Minas Geraes. Internat. Bull. Pl. Prot. 9 (5): 104-105. 1935. (RAM 14: 634).
_____ El reconocimiento de las enfermedades de las plantas cultivadas en Venezuela. 1937-1941. Bol. Soc. venez. Cien. nat. 7 (48): 99-113. 1941. (RAM 21: 324. 1942).

Smith, Floyd F., and Philip Brierley. Preliminary report on some mosaic diseases of Iridaceous plants. Phytopath. 34: 1944. (in press).
Williams, P. H., Oyler, Enid, White, H. L., Ainsworth, G. C., and W. H. Read. Plant diseases. Rep. Exp. Sta. Cheshunt 1938: 39-63. 1939. (RAM 18: 783).

HOLODISCUS-WITCHES'-BROOM VIRUS

Name: Holodiscus Virus 1 (Zeller) Smith 1937
Nanus holodisci Holmes 1939

Synonyms: Holodiscus-witches'-broom virus Zeller 1931

Common name: Holodiscus-witches'-broom virus

Geographic distribution: Oregon, Washington.

Host range: ROSACEAE--Holodiscus discolor (Pursh) Maxim.

Symptoms: Lateral buds proliferate to form slender shoots with short internodes and small leaves. Plants appear stiff and leafy, usually fail to bloom, and assume a bronzy-red color in early summer.

Methods of transmission: Transmissible by grafting, not by sap. By Aphis spireae Schout.

Properties: Not determined.

Literature:

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 127-128.
Smith, K. M. A textbook of plant virus diseases. London 1937. p. 127-128.
Zeller, S. M. A witches' broom of ocean spray (Holodiscus discolor). Phytopath. 21: 923-925. 1931.

(HUMULUS) HOP-CHLOROTIC-DISEASE VIRUS

Name: Humulus Virus 3 (Salmon and Ware) Smith 1937

Synonyms: Hop chlorotic disease virus Salmon and Ware 1930

Common name: Hop-chlorotic-disease virus.

Geographic distribution: Worcestershire, England.

Host range: MORACEAE--Humulus lupulus L.

Symptoms: Weak growth. In leaves yellow mottling, banding, or general yellowing except at the leaf tips. Sometimes marked curling. Chlor-

otic areas much thinner than normal, with fewer cell layers, shorter palisade cells, and fewer chloroplasts. Illustrated by Salmon and Ware 1930.

Methods of transmission: By budding and grafting (1930). By sap (1932a). No vector is known. Apparently through seed (1935) (Salmon and Ware).

Properties: Not determined.

Literature:

Salmon, E. S., and Ware, W. M. The chlorotic disease of the hop. Ann. Appl. Biol. 17: 241-247. 1930.
_____, and _____ The chlorotic disease of the hop. II. Ann. Appl. Biol. 19: 6-15. 1932 (a)
_____, and _____ The chlorotic disease of the hop. III. Ann. Appl. Biol. 19: 518-528. 1932 (b).
_____, and _____ The chlorotic disease of the hop. IV. Transmission by seed. Ann. Appl. Biol. 22: 728-730. 1935.
Smith, K. M. A textbook of plant virus diseases. London 1937. p. 194-196.

(HUMULUS) HOP-INFECTIOUS-STERILITY VIRUS

Name:

Synonyms:

Common name: Hop-infectious-sterility virus Blattný and Vukolov 1935

Geographic distribution: Czechoslovakia.

Host range: MORACEAE--Humulus lupulus L.

Symptoms: Total or nearly total unfruitfulness. Plants usually reach normal height, but produce few laterals. Apical shoots profusely developed with short internodes and necrotic tips. Leaves sometimes curled backward and distorted. Phloem necrosis is general in terminal and lateral growing points, also in petioles and leaf veins.

Methods of transmission: By grafting. Not by sap. Not by soil. No vector is known.

Properties: Not determined.

Literature:

Blattný, C., and Vukolov, V. Nakažlivá neplodnost chmele. Rec. Inst. Rech. agron. Rép. Tchecoslovaque 137, p. 3-18 (German summary). 1935.
Goodwin, W., and Salmon, E. S. Infectious sterility in hop gardens in Czechoslovakia. Jour. Inst. Brew. n. s. 33: 209-210. 1936

(HUMULUS) HOP-MOSAIC VIRUS

Name: Humulus Virus 1 (Salmon) Smith 1937

Synonyms: Hop mosaic virus Salmon 1923
Hop false nettlehead virus Duffield 1925

Common name: Hop-mosaic virus

Geographic distribution: Widespread in Europe--Czechoslovakia, England, Germany, Poland (Smith 1937); possibly United States (Chupp 1933).

Host range: MORACEAE--Humulus lupulus L.

Symptoms: Plants are dwarfed, fail to cling to supports, bear malformed cones or none. The upper part of the stem is brittle, sometimes dies back. Leaves are brittle, mottled green and yellow, with margins curled downward and inward. The disease is eventually fatal (Salmon 1923).

Methods of transmission: By grafting (Thrupp 1927). Not by sap (Salmon 1925). Not through soil (Salmon 1936). No vector is known.

Properties: Not determined.

Remarks:
Many American, Danish, English, German, and seedling varieties and some male hops are symptomless carriers of mosaic (MacKenzie et al 1929).

Literature:

Cheal, W. F. Investigations of hop mosaic disease in the field. Ann. Appl. Biol. 16: 230-235. 1929.

Chupp, C. Downy mildew of hops in New York. Plant Disease Reporter 17: 103-104. 1933.

Duffield, C. A. W. Nettlehead in hops. Ann. Appl. Biol. 12: 536-543. 1925.

MacKenzie, D., Salmon, E. S., Ware, W. M., and Williams, R. The mosaic disease of the hop; grafting experiments, II. Ann. Appl. Biol. 16: 359-381. 1929.

Salmon, E. S. The "mosaic" disease of the hop. Journ. Min. Agr. 29: 927-934. 1923.

_____ Fungus and virus diseases of the hop. Journ. Inst. Brew. n. s. 33: 184-186. 1936.

_____, and Ware, W. M. The mosaic disease of the hop; grafting experiments, I. Ann. Appl. Biol. 15: 342-351. 1928.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 193.

Thrupp, T. C. The transmission of mosaic disease in hops by means of grafting. Ann. Appl. Biol. 14: 175-180. 1927

(HUMULUS) HOP-NETTLEHEAD VIRUS

Name: Chlorogenus humuli Holmes 1939
Humulus Virus 2 (Duffield) Smith 1937

Synonyms: Hop nettlehead (virus) Duffield 1925
Hop-nettlehead virus Salmon and Ware 1930
? Kräuselkrankheit (virus) Blattný 1930

Common name: Hop-nettlehead virus

Geographic distribution: England. A somewhat similar disease of hops is known in Czechoslovakia, Germany, and Poland. (Smith).

Host range: MORACEAE--Humulus lupulus L.

Symptoms: Brooming, clusters of weak shoots, upward curling and elongation of leaves, barrenness.

Methods of transmission: By grafting (Keyworth, 1941, 1942). Not by sap. No vector is known.

Properties: Not determined.

Literature:

Blattný, C. Studie o kadeřavosti Chmele. Rec. Inst. Rech. agron. Rép. Tchecoslovaque 56, 44 pp. (German summary) 1930.

Duffield, C. A. W. Nettlehead in hops. Ann. Appl. Biol. 12: 536-543. 1925.

Keyworth, W. G. Verticillium wilt and virus diseases of the hop. Ann. Appl. Biol. 29: 323-324. 1942.

_____ Notes on hop diseases in 1941. East Malling Res. Sta. Ann. Rept. (29th) 1941: 42-43. 1941.

Salmon, E. S. Fungus and virus diseases of the hop. Journ. Inst. Brew. n. s. 33: 184-186. 1936.

_____ Diseases of hops. Journ. Inst. Brew. n. s. 32: 235-237. 1935.

_____, and Ware, W. M. "Nettlehead" disease of the hop. In Report from the Mycological Department. Journ. S.-Eastern Agric. Coll. 27: 95. 1930.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 194.

HYDRANGEA-VIRESCENCE VIRUS

Name:

Synonyms: Hortensia-Vergrünung (virus)

Common name: Hydrangea-virescence virus

Geographic distribution: Germany.

Host range: SAXIFRAGACEAE--Hydrangea macrophylla (Thunb.) DC. (H. opuloides K. Koch).

Symptoms: Green discoloration of the flowers.

Methods of transmission: By grafting.

Properties: Not determined.

Literature:

Muth, F. Über vergrünte Hortensien. In Bericht der Lehr- und Forschungsanstalt für Wein-, Obst- und Gartenbau zu Geisenheim a. Rh. für Rechnungsjahre 1931-32. Landw. Jahrb. 77 (Ergänzungsband): 222-223. 1933

HYOSCYAMUS-MOSAIC VIRUS

Name: Hyoscyamus Virus 1 (Hamilton) Smith 1937

Synonyms: Hyoscyamus virus III (Hy III) Hamilton 1932

Common name: Hyoscyamus-mosaic virus

Geographic distribution: England.

Host range: SOLANACEAE--Hyoscyamus niger L., Datura stramonium L., Lycopersicon esculentum Mill., Nicotiana tabacum L., N. glutinosa L., N. glauca Graham, Petunia sp. (Hamilton 1932).

Symptoms: In Hyoscyamus niger, clearing of veins followed by yellow mosaic with dark green vein-banding. In Datura stramonium, yellow mosaic with tendency to dark green vein-bands and blistering. In tomato, mottling, stunting, marked curling of leaves. In tobacco, yellow mottling with blistered dark green bands. In Nicotiana glutinosa, systemic vein-banding in 14-15 days, white stripe flower break. In N. glauca, violent necrosis, blistering, stunting. In Petunia, yellow vein-banding, necrosis in older leaves. Sometimes lethal to tobacco and Hyoscyamus (Hamilton 1932). Intracellular inclusions present (Hamilton 1932, Sheffield 1934, Bawden & Kassanis 1941).

Methods of transmission: By sap. By Myzus persicae (Sulz.) (Hamilton 1932). By Macrosiphum gei (Koch), Myzus circumflexus (Buckt.) (Watson & Roberts 1939). Not through seed (Caldwell 1934).

Properties: Thermal inactivation point between 50° and 60°C. Resistance to aging less than 6 days (Watson 1936). Active in dilutions of 1 to 10,000 (Watson & Roberts 1939). Filterable through Chamberland L1 candle, not through L3 (Hamilton 1932). Passes collodion membranes of pore size 0.30 μ but not 0.234 μ (MacClement & Smith 1932). Hyoscyamus virus 3 has yielded liquid crystalline

nucleoprotein preparations showing anisotropy of flow and with properties similar to those of preparations from potato virus Y. Yields are 1–3 mg. per liter of sap. The protein gives specific precipitates with antisera and is infective (Bawden & Pirie 1939).

Remarks:

Hyoscyamus virus 3, potato virus Y, and tobacco-severe-etch virus are transmitted by the same insects in the "non-persistent" manner and have essentially similar properties. The viruses are not serologically related, and tobacco plants infected with Hyoscyamus virus 3 or potato virus Y are not protected against tobacco-severe-etch virus. Potato virus Y and Hyoscyamus virus 3 may be regarded as separate species of the same genus as tobacco-severe-etch virus (Bawden & Kassanis 1941).

Three strains of Hyoscyamus virus 3 isolated by single aphids from the parent strain are distinguished as a virulent strain, a weak strain, and a yellow strain (Watson & Roberts 1939).

Hyoscyamus virus 3 belongs to the "non-persistent" group of viruses which are transmitted by aphids, survive for a brief period in their vectors, lack a "latent period" in these vectors, and are transmitted most efficiently (a) when the vector is starved for 1 hour or more before feeding on the source plant, and (b) when the feeding time on the source plant is short (2 minutes) (Watson & Roberts 1939).

Literature:

Bawden, F. C., and Kassanis, B. Some properties of tobacco etch viruses. Ann. Appl. Biol. 28: 107–118. 1941.

_____, and Pirie, N. W. The purification of insect-transmitted plant viruses. Brit. Journ. Exp. Path. 20: 322–329. 1939.

Caldwell, J. The physiology of virus diseases in plants. V. The movement of the virus agent in tobacco and tomato. Ann. Appl. Biol. 21: 191–205. 1934.

Hamilton, M. A. On three new virus diseases of Hyoscyamus niger. Ann. Appl. Biol. 19: 550–567. 1932.

MacClement, D., and Smith, J. H. Filtration of plant viruses. Nature 130: 129–130. 1932.

Sheffield, F. M. L. Experiments bearing on the nature of intracellular inclusions in plant virus diseases. Ann. Appl. Biol. 21: 430–453. 1934.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 331.

Watson, M. A. Factors affecting the amount of infection obtained by aphis transmission of Virus Hy. III. Phil. Trans. Roy. Soc. 226: 457–489. 1936.

_____ Further studies on the relationship between Hyoscyamus virus 3 and the aphid Myzus persicae (Sulz.) with special reference to the effects of fasting. Proc. Roy. Soc. B. 125; 144–170. 1938

_____, and Roberts, F. M. A comparative study of the transmission of Hyoscyamus virus 3, potato virus Y and cucumber virus 1 by the vectors Myzus persicae (Sulz.), M. circumflexus (Buckton) and Macrosiphum gei (Koch). Proc. Roy. Soc. B. 127: 543–576. 1939.

ILEX-VARIEGATION VIRUS

Name:

Synonyms:

Common name: Ilex-variegation virus

Geographic distribution: England, France.

Host range: AQUIFOLIACEAE--*Ilex* spp.

Symptoms: Variegation.

Methods of transmission: By grafting (Blair 1719, Carrière 1887).

Properties: Not determined.

Literature:

Atanasoff, D. Old and new virus diseases of trees and shrubs. Phytopath. Zeitschr. 8: 197-223. 1935.

Blair, P. Botanic Essays. London 1719. pp. 383-386 (cited by Atanasoff).

Carrière, E. A. Influence du greffon sur le sujet. Revue Horticole 59: 58-59. 1887.

IRIS-MOSAIC VIRUS

Name: *Iris* Virus 1 (Brierley & McWhorter) Smith 1937
Marmor iridis Holmes 1939

Synonyms: Iris mosaic virus
Iris stripe virus

Common name: Iris-mosaic virus

Geographic distribution: Widespread. Denmark, England, France, Holland, Japan, Sweden, United States.

Host range: IRIDACEAE--*Iris filifolia* Boiss., *I. pumila* L., *I. ricardi* Hort., *I. tectorum* Maxim., *I. tingitana* Boiss & Reut., *I. unguicularis* Poir., *I. xiphium* L.

Symptoms: Mottling of leaves, breaking of flower colors.

Methods of transmission: By sap. By the aphids, *Myzus persicae* Sulz., *Macrosiphum solanifolii* Ashm. (= *Illinoia solanifolii* Ashm.).

Properties: Not determined.

Literature:

Brierley, P., and McWhorter, F. P. A mosaic disease of bulbous iris. Phytopath. 24: 4. 1934 (Abst.)

Brierley, P., and McWhorter, F. P. A mosaic disease of iris. Journ. Agric. Res. 53: 621-635. 1936.
Dufrenoy, J. Die Viruskrankheiten. Phytopath. Zeitschr. 5: 85-90. 1932.
Fukushi, T. A contribution to our knowledge of virus diseases of plants in Japan. Trans. Sapporo Nat. Hist. Soc. 12: 130-141. 1932.
Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 55-56.
Ingelström, E. Några aktuella sjukdomar på prydnadsvaxter. Växtskyddsnotiser Växtyskyddsinst. Stockh. 1938 (2): 22-24. 1938. (RAM 17: 752).
Neergaard, P. Nye eller upaaagtede Prydplantssygdomme i Danmark 9-12. Reprinted from Gartnertidende 1940, 4 pp. 1940 (RAM 20: 579).
Smith, K. M. A textbook of plant virus diseases. London 1937 p. 420-422.

JASMINUM-VARIEGATION VIRUS

Name:

Synonyms:

Common name: Jasmine-variegation virus

Geographic distribution: Belgium, England, Germany.

Host range: OLEACEAE--*Jasminum revolutum* Sims, *J. officinalis* L.

Symptoms: Yellow variegation in leaves and young branches.

Methods of transmission: By grafting or budding (Lawrence 1715, Blair 1719, Cane 1720, Godsall 1869).

Properties: Not determined.

Literature:

Atanasoff, D. Old and new virus diseases of trees and shrubs. Phytopath. Zeitschr. 8: 197-223. 1935.
Blair, P. Botanic essays. pp. 383-386. London 1715. (Cited by Atanasoff).
Cane, H. An account of two observations in gardening, upon the changes in color in grapes and Jessamine. Roy. Soc. Phil. Trans. Ser. B. 31: 102. 1720. (Cited by Atanasoff).
Godsall, W. Gard. Chron. 1869: 838. 1869.
Lawrence, John. The clergyman's recreation. London. 1715. p. 95. (Extract by W. A. Orton. An early report on infectious chlorosis. Phytopath. 14: 198-199. 1924).
Smith, K. M. A textbook of plant virus diseases. London 1937. p. 554.

LABURNUM-VARIEGATION VIRUS

Name: Marmor laburni Holmes 1939. p. 51

Synonyms: Laburnum infectious chlorosis (virus) Baur 1906

Common name: Laburnum-variegation virus

Geographic distribution: Bulgaria, England, Germany.

Host range: LEGUMINOSAE--Cytisus hirsutus L. (Baur 1907), Laburnum anagyroides Medik. (L. vulgare Griseb.)

Symptoms: Green and yellow leaf variegation.

Methods of transmission: By grafting (Masters 1877), budding, or transplantation of bark (Baur 1907). Not through seed.

Properties: Not determined.

Remarks:

Laburnum vulgare chrysophyllum exhibits a uniform yellowish chlorosis of leaves; L. vulgare foliis aureis shows golden variegation in leaves and young bark; both forms are produced by the same infectious chlorosis in different clons of L. vulgare. L. alpinum and Cytisus purpureus are insusceptible plants (Baur 1906, 1907).

Literature:

Atanasoff, D. Old and new virus diseases of trees and shrubs. Phytopath. Zeitschr. 8 (2): 197-223. 1935.

Baur, E. Weitere Mitteilungen über die infektiöse Chlorose der Malvaceen und über einige analoge Erscheinungen bei Ligustrum und Laburnum. Bericht. d. Deutsch. Bot. Gesellsch. 24: 416-428. 1906.

_____ Über infektiöse Chlorosen bei Ligustrum, Laburnum, Fraxinus, Sorbus, und Ptelea. Bericht. d. Deutsch. Bot. Gesellsch. 25: 410-413. 1907.

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 51.

Masters, M. T. Action of scion on stock. Gard. Chron. 7: 730. 1877.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 555.

(LATHYRUS) SWEETPEA-STREAK VIRUS

Name:

Synonyms:

Common name: Sweetpea-streak virus

Geographic distribution: England (Ainsworth 1940) (Widespread if this virus is a leading causal agent of sweetpea streak, formerly attributed to Bacillus lathyri).

Host range: LEGUMINOSAE--Lathyrus odoratus L., Phaseolus vulgaris L., Pisum sativum L. var. The Lincoln (but not var. Perfection), Trifolium repens L., Vicia faba L.

Symptoms: In Lathyrus odoratus brown necrotic streak lesions in stems and petioles, mosaic mottling of leaves, breaking of flower color. In Pisum sativum, mottling, stunting, vein necrosis, occasionally death. In Vicia faba, reddish brown streaks, stunting. In Phaseolus vulgaris, systemic mottling. In Trifolium repens, mild mosaic mottling.

Methods of transmission: By sap.

Properties: Thermal inactivation between 50° and 55°C. Withstands aging in expressed juice 24 hours, not 48 hours.

Remarks:

Sweetpea-streak virus, isolated from naturally affected sweetpeas, proved distinct from the viruses of bean mosaic, mild, yellow, and enation pea mosaics, lettuce mosaic, cucumber mosaic, and tomato spotted wilt, which were compared with it, and appeared allied to bean virus 2 (Pierce 1934; Zaumeyer & Wade 1935 (pea virus 2)), white sweetclover mosaic virus (Zaumeyer & Wade 1935, 1936), and the severe pea mosaic of Johnson and Jones (1937). Although sweetpea-streak virus appears to belong to the same group as the 3 viruses last named, it cannot with certainty be identified with any of these (Ainsworth 1940).

Literature:

Ainsworth, G. C. The identification of certain viruses found infecting leguminous plants in Great Britain. Ann. Appl. Biol. 27: 218-226. 1940.

Johnson, F., and Jones, L. K. Two mosaic diseases of pea in Washington. Journ. Agric. Res. 54: 629-638. 1937.

Pierce, W. H. Viroses of the bean. Phytopath. 24: 87-115. 1934.

Zaumeyer, W. J., and Wade, B. L. The relationship of certain legume mosaics to bean. Journ. Agric. Res. 51: 715-749. 1935.

_____, and _____ Pea mosaic and its relation to other legume mosaic viruses. Journ. Agric. Res. 53: 161-185. 1936.

LIGUSTRUM-VARIEGATION VIRUS

Name: Marmor ligustri Holmes 1939, p. 52

Synonyms: Ligustrum infectious chlorosis (virus) Baur 1906

Common name: Ligustrum-variegation virus

Geographic distribution: Germany

Host range: OLEACEAE--Ligustrum vulgare L.

Symptoms: Clear yellow leaf spotting.

Methods of transmission: By grafting or budding. Not through seed.

Properties: Not determined.

Remarks:
Baur (1906) found infectious chlorosis present in the yellow-mottled variety Ligustrum vulgare foliis aureovariegatis but not in the white-margined variety or the aureum variety.

Literature:

Baur, E. Weitere Mitteilungen über die infektiöse Chlorose der Malvaceen und über einige analoge Erscheinungen bei Ligustrum und Laburnum. Bericht. d. Deutsch. Bot. Gesellsch. 24: 416-428. 1906.

_____ Über infektiöse Chlorosen bei Ligustrum, Laburnum, Fraxinus, Sorbus, und Ptelea. Bericht. d. Deutsch. Bot. Gesellsch. 25: 410-413. 1907.

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 52.

(LILIUM) LILY-ROSETTE VIRUS

Name: Lilium Virus 1 (Ogilvie) Smith 1937

Synonyms: Lily yellow flat virus (Ogilvie 1928).
Lily rosette virus (British Mycol. Society 1929).

Common name: Lily-rosette virus.

Geographic distribution: Bermuda, England (Cotton 1933), Holland Van Poeteren 1929), Japan (Kawamura 1938), Java (Van Der Goot 1934), United States.

Host range: LILIACEAE--Lilium longiflorum Thunb., possibly also L. auratum Lindl. (Smith 1936), and L. batemanniae Wallace (Guterman 1930).

Symptoms: Dwarfing, yellowing. Downward curling of leaves. Early maturity.

Methods of transmission: By Aphis gossypii Glover. Not by sap. Not through seed.

Properties: Not determined.

Remarks:
This virus has been experimentally transmitted to Lilium longiflorum and its varieties only, but similar symptoms in L. batemanniae are reported by Guterman (1930) and in L. auratum by Smith (1936).

Literature:

British Mycological Society. List of common names of British plant diseases. Trans. Brit. Mycol. Soc. 14: 140-177. 1929

Cotton, A. D. The detection and control of lily diseases. Royal Hort. Soc. Lily Year Book 1933: 194-210. 1933.

Dufrenoy, J. Changes in the structure of the cells induced by the 'yellow flat' virus disease of Easter lilies. Proc. Louisiana Acad. Sci. 6: 35. 1942.

Guterman, C. E. F. Final summary of the work on diseases of lilies for the lily disease investigation fellowship. Yearbook New York Hort. Soc. 1930: 51-102. 1930.

Kawamura, T. So-called virus diseases of lily in relation to hosts. Ann. Phytopath. Soc. Japan 7: 163-172. 1938.

Ogilvie, L. An important virus disease of Lilium longiflorum and its varieties. Nature 119 (2997): 528. 1927.

_____ A transmissible virus disease of the Easter lily. Ann. Appl. Biol. 15: 540-562. 1928.

Smith, K. M. The virus diseases of glasshouse and garden plants. Sci. Hort. 4: 126-140. 1936.

_____ A textbook of plant virus diseases. London 1937, p. 415.

Van Der Goot, P. Ziekten en plagen der cultuurgewassen in Nederlandsch-Indie in 1932. Meded. Inst. voor Plantenziekten, 83, 80 pp. 1934 (RAM 14: 153).

Van Poeteren, N. Verslag over de werkzaamheden van den Plantenziektenkundigen Dienst in het jaar 1929. Versl. en Meded. Plantenziektenkundigen Dienst te Wageningen, 62, 142 pp. 1930 (RAM 10: 293).

(LILIUM) LILY-SYMPTOMLESS VIRUS

Name: Adelonosus lilii Brierley and Smith 1944

Synonyms:

Common name: Lily-symptomless virus

Geographic distribution: Bermuda, Japan, United States.

Host range: LILIACEAE--Lilium longiflorum Thunb.

Symptoms: No symptoms alone; necrotic fleck when present together with cucumber- mosaic virus (Marmor cucumeris Holmes 1939).

Methods of transmission: By sap (with difficulty). By Aphis gossypii Glover. Not through seed.

Properties: Not determined.

Remarks:

An essential constituent of necrotic fleck in Lilium longiflorum, this virus is present where necrotic fleck occurs, hence is practically coextensive with commercial culture of Easter lilies. Earlier literature on the necrotic fleck disease of Easter lily is reviewed by

Brierley & Smith. This virus has a latent period of a few days in the vector Aphis gossypii. It fails to protect against lily-rosette virus.

Literature:

Brierley, P., and Smith, Floyd F. Studies on lily virus diseases: the necrotic fleck complex in Lilium longiflorum. Phytopath. 34: 1944. (in press).

LONICERA-VARIEGATION VIRUS

Name:

Synonyms: Lonicera variegation-inducing agent Woods and DuBuy

Common name: Lonicera-variegation virus

Geographic distribution: Belgium, United States.

Host range: CAPRIFOLIACEAE--Lonicera japonica Thunb. (Synonym L. brachypoda reticulata Witte, of horticulture).

Symptoms: Vein-yellowing variegation.

Methods of transmission: By grafting.

Properties: Not determined.

Literature:

Woods, M. W., and H. G. DuBuy. Evidence for the evolution of pathogenic viruses from mitochondria and their derivatives. I. Cytological and genetic evidence. Phytopath. 33: 637-655. 1943.

MATTHIOLA-MILD-MOSAIC VIRUS

Name: Matthiola Virus 1 (Tompkins) Smith 1937

Synonyms: Matthiola-breaking virus Tompkins 1934
Matthiola mild mosaic virus Tompkins 1939
? Matthiola panache Chaté 1867
? Wallflower mosaic virus Smith 1937. p. 19

Common name: Matthiola-mild-mosaic virus

Geographic distribution: California (Tompkins 1934), England? (Smith 1937), France? (Chaté 1867), Australia? (Noble et al 1934), Italy? (Gigante 1936).

Host range: CHENOPODIACEAE--Chenopodium murale L. Cruciferae--Alyssum maritimum Lam., Brassica adpressa (Moench) Boiss., B. alba (L.) Boiss., B. juncea (L.) Coss., B. kaber (DC.) L. C. Wheeler

(B. arvensis (L.) Ktze.), B. nigra (L.) Koch., B. pekinensis Rupr. (B. pe-tsai Bailey), B. rapa L., Capsella bursa-pastoris (L.) Medik., Cheiranthus cheiri L., Hesperis matronalis L., Lunaria annua L., Malcomia maritima (L.) R.Br., Matthiola incana (L.) R. Br. var. annua (L.) Voss., M. bicornis (Sibth. & Sm.) DC., Raphanus sativus L., R. sativus var. longipinnatus Bailey. RESEDACEAE--Reseda odorata L. SOLANACEAE--Nicotiana glutinosa L., N. langsdorffii Weinm., N. tabacum L.

Symptoms: In annual stocks, vein clearing followed by mild mottling in leaves, mild breaking of flower color in all but white or yellow varieties. In Nicotiana langsdorffii, systemic mottling; in N. glutinosa and N. tabacum, necrotic local lesions. No infection in Chenopodium album L., Spinacia oleracea L., or Petunia hybrida Vilm.

Methods of transmission: By sap (symptoms after about 20 days). Not by seed. By Brevicoryne brassicae (L.), Lipaphis pseudobrassicae (Davis), Myzus persicae (Sulz.).

Properties: Thermal inactivation point at or near 60°C. Dilution tolerance 1:4000. Withstands aging in vitro between 5 and 6 days at 22°C.

Remarks:

Failure to infect kale, Brussels sprouts, cabbage, cauliflower, sprouting broccoli, kohlrabi, and rape, characterizes both Matthiola mild mosaic and Matthiola severe mosaic, and serves to distinguish these viruses from certain other crucifer viruses.

Interpretation of distribution records based on observation of symptoms is impracticable, as "Flower breaking of annual stock may also be induced by the Chinese cabbage, turnip, horseradish, and cabbage-mosaic viruses and the cabbage black-ring virus." (Tompkins 1939)

Literature:

Chaté, E., fils. Culture pratique des giroflées des divers modes d'essimplage. 95 pp. Paris. 1867

Gigante, R. Il mosaico della violaciocca. R. Staz. Patol. Veg. Roma Boll. (n.s.) 16: 166-174. 1936.

Noble, R. J., Hynes, H. J., McCleery, F. C., and Birmingham, W. A. Plant diseases recorded in New South Wales. N. S. Wales Dept. Agric. Sci. Bull. 46. 47 pp. 1934.

Smith, K. M. Colour changes in wallflowers and stocks. Gard. Chron. III, 98: 112. 1935

_____ The virous diseases of glasshouse and garden plants. Sci. Hort. 4: 126-140. 1936.

_____ Matthiola virus 1. In A textbook of plant virus diseases. London 1937. p. 18-21.

Tompkins, C. M. Breaking in stock (Matthiola incana), a virosis. Phytopath. 24: 1137. 1934. (Abst.).

_____ Two mosaic diseases of annual stock. Journ. Agr. Res. 58: 63-77. 1939

MATTHIOLA-SEVERE-MOSAIC VIRUS

Name:

Synonyms:

Common name: Matthiola-severe-mosaic virus

Geographic distribution: California

Host range: CHENOPODIACEAE--Chenopodium album L., Spinacia oleracea L. CRUCIFERAE--Brassica alba (L.) Boiss., B. kaber (DC.) L. C. Wheeler (B. arvensis (L.) Ktze.), B. nigra (L.) Koch., B. rapa L., Capsella bursa-pastoris (L.) Medik., Hesperis matronalis L., Matthiola incana (L.) R.Br. var. annua(L.) Voss., M. bicornis (Sibth. & Sm.) DC. RESEDACEAE---Reseda odorata L. SOLANACEAE--Nicotiana tabacum L., Petunia hybrida Vilm.

Symptoms: In annual stocks, coarse very conspicuous chlorotic mottling in leaves, very coarse breaking of flower color in all but white and yellow varieties. In Nicotiana tabacum, necrotic local lesions. No infection in Chenopodium murale, Alyssum maritimum, Brassica adpressa, B. juncea, B. pekinensis, Cheiranthus cheiri, Lunaria annua, Malcomia maritima, Nicotiana langsdorffii, or N. glutinosa.

Methods of transmission: By sap (symptoms after about 14 days). Not by seed. By Brevicoryne brassicae (L.), Lipahis pseudobrassicae (Davis), Myzus persicae (Sulz.).

Properties: Thermal inactivation point near 60°C. Dilution tolerance 1:3000. Withstands aging in vitro between 7 and 8 days at 22°C.

Remarks:
Failure to infect kale, Brussels sprounts, cabbage, cauliflower, sprouting broccoli, kohlrabi, and rape, characterizes both Matthiola severe mosaic and Matthiola mild mosaic, and serves to distinguish these viruses from certain other crucifer viruses (Tompkins 1939).

Literature:
Tompkins, C. M. Two mosaic diseases of annual stock. Journ. Agric. Res. 58: 63-77. 1939.

NARCISSUS-MOSAIC VIRUS

Name:

Synonyms: Narcissus yellow stripe (virus) Darlington 1908
Narcissus gray disease (virus) McKay 1926
Bulb plant mosaic virus Atanasoff 1928 (In part)
Narcissus gray disease virus McWhorter 1932

Narcissus mosaic virus McWhorter and Weiss 1932
Narcissus stripe-disease virus Caldwell et al 1938, 1943. (In part)

Common name: Narcissus-mosaic virus

Geographic distribution: Widespread--Australia (Buckland 1906), England (Darlington 1908), Bermuda (Ogilvie 1928), Bulgaria and Holland (Atanasoff 1928), Japan (Fukushi 1932), United States.

Host range: AMARYLLIDACEAE--Narcissus spp. and hybrids.

Symptoms: Dwarfing and reduced yield. In leaves systemic chlorotic streaking, pale green, grayish, or yellow; in some varieties (King Alfred) necrotic streaking; malformation and epidermal roughening. In flowers opaque, frost-like streaks and blotches, sometimes malformation.--Haasis 1939.

Methods of transmission: By bulb grafting (Van Slogteren 1938, Haasis 1939, Caldwell and Prentice 1943). By sap (McWhorter 1932, Van Slogteren 1938, Haasis 1939, Caldwell and Prentice 1943). By the aphids Anuraphis roseus (Baker), Aphis rumicis L., Macrosiphum (Illinoia) solanifolii (Ashm.), M. pisi (Kalt.), M. rosae (L.), Myzus cerasi (F.), and M. convolvuli (Kalt.) (Blanton and Haasis 1942). Not through seed or through soil (Haasis 1939, Caldwell and Prentice 1943). Possibly by root contact (McWhorter 1932, Hawker 1943). Symptoms appear in the season following inoculation.

Properties: Thermal inactivation point 70° to 75°C. Dilution end-point between 1:100 and 1:200. Resists aging for 72 hours at 21° to 24°C. Does not pass Pasteur-Chamberland filters L_2, L_5, or L_7. --Haasis 1939.

Remarks:

Smith's (1937) treatment of narcissus-mosaic virus as a synonym of Tulipa virus 1 on the strength of Atanasoff's (1928) meager data is not justified by more recent work of Haasis (1939) and Caldwell and Prentice (1943), which indicates this virus is restricted to Narcissus.

McWhorter and Weiss (1932) and Caldwell and James (1938) suggested that more than one virus is involved in narcissus mosaic, but more recent cross-inoculations by Haasis (1939) and by Caldwell and Prentice (1943) indicate that the symptoms of narcissus mosaic, including the leaf proliferations, are caused by a single virus.

Literature:

Atanasoff, D. Mosaic disease of flower bulb plants. Bull. Soc. Bot. Bulgarie 2: 51-60. 1928.

Blanton, F. S., and Haasis, F. A. Transmission of the narcissus mosaic virus by aphids. Journ. Econ. Entomol. 32: 469-470. 1939.

_____, and _____ Three additional species of aphids transmitting narcissus mosaic. Journ. Econ. Entomol. 33: 942. 1940.

Blanton, F. S., and Haasis, F. A. Insect transmission of the virus causing narcissus mosaic. Journ. Agr. Res. 65: 413-419. 1942.

Buckland, L. Daffodil yellow-stripe diseases. Garden 70: 52. 1906.

Caldwell, J. "Stripe" disease of narcissus. Nature 142: 441. 1938.

_____, and James, A. L. An investigation into the "stripe" disease of narcissus. I. The nature and significance of the histological modifications following infection. Ann. Appl. Biol. 25: 244-253. 1938.

_____, and Prentice, I. W. An investigation into the "stripe" disease of narcissus. II. Experiments on the virus agent and its spread. Ann. Appl. Biol. 30: 27-32. 1943.

Darlington, H. R. Yellow-stripe in daffodils. Journ. Roy. Hort. Soc. 34: 161-166. 1908.

Fukushi, T. A contribution to our knowledge of virus diseases of plants in Japan. Trans. Sapporo Nat. Hist. Soc. 12: 130-141. 1932.

Haasis, F. A. Studies on narcissus mosaic. New York Cornell Agric. Exp. Sta. Memoir 224: 1-22. 1939.

Hawker, Lilian E. Experiments on the rate of spread of narcissus stripe in the field. Ann. Appl. Biol. 30: 184-185. 1943.

McKay, M. B. Narcissus and tulip diseases. Oregon State Hort. Soc. Ann. Rept. 18: 137-149. 1926.

McWhorter, F. P. Narcissus "gray disease" is a transmissible mosaic. Florists' Exch. 79 (14): 11. 1932.

_____ Narcissus-mosaic symptoms. Phytopath. 22: 998. 1932. (Abst.).

_____ The symptoms of narcissus mosaic developed within the plant. Phytopath. 25: 896-897. 1934. (Abst.).

_____, and Weiss, F. Diseases of narcissus. Oregon Agric. Exp. Sta. Bull. 304: 5-41. 1932.

Ogilvie, L. Virus diseases of plants in Bermuda. Bermuda Dept. Agric. Bull. 7 (8): 4-7. 1928.

Slogteren, E. van. The transmission of virus diseases in daffodils. Chronica Botanica 4: 205. 1938.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 414.

NARCISSUS-WHITE-STREAK VIRUS

Name:

Synonyms: Narcissus silver streak (virus) Chittenden 1933
Narcissus white streak (virus) McWhorter 1938

Common name: Narcissus-white-streak virus

Geographic distribution: Widespread. England and Holland (Chittenden 1933), United States.

Host range: AMARYLLIDACEAE--Narcissus spp. and hybrids.

Symptoms: In leaves narrow dark green streaks becoming prominent as white, gray, or yellowish white streaks after the flowering period. Similar streaks in flower stems (Haasis 1939). Early maturity, with purple or white streaking (McWhorter 1938).

Methods of transmission: By sap (Haasis 1939), symptoms in the season following inoculation. By Aphis rumicis L. and Macrosiphum (Illinoia) solanifolii (Ashm) (Blanton 1939).

Properties: Not determined.

Remarks:

The white streaks are dead areas of sunken epidermal or chlorenchyma cells, whereas the yellow streaks of narcissus mosaic are overgrowths of living cells (McWhorter 1939). White-streaking symptoms are expressed at temperatures in excess of 65°F, and become more conspicuous after flowering (Haasis 1939), whereas mosaic mottling tends to be less distinct after flowering (McWhorter and Weiss 1932).

Literature:

Blanton, F. S. Aphid transmission of the virus causing white streak of narcissus. Journ. Econ. Entomol. 32: 726-727. 1939.

Chittenden, F. J. Mosaic disease of narcissi. Roy. Hort. Soc. Daffodil Yearbook 1933: 72-73. 1933.

Haasis, F. A. White streak, a virus disease of narcissus. Phytopath. 29: 890-895. 1939.

McWhorter, F. P. Narcissus mosaic and early maturity. U. S. Bur. Plant Indus. Plant Disease Reporter 22: 147-148. 1938.

_____ The white streak or white stripe disease of narcissus. Phytopath. 29: 826. 1939. (Abst.).

_____ The distribution of zilverblad or white streak in narcissus plantings on the West Coast. U. S. Bur. Plant Indus. Plant Disease Reporter 24: 20-24. 1940.

_____, and Weiss, F. Diseases of narcissus. Oregon State Coll. Agr. Exp. Sta. Bull. 304: 5-41. 1932.

(NERIUM) OLEANDER-VARIEGATION VIRUS

Name:

Synonyms: Oleander variegation (virus) Guicciardi 1831

Common name: Oleander-variegation virus.

Geographic distribution: Italy.

Host range: APOCYNACEAE--Nerium oleander L.

Symptoms: Leaf variegation.

Methods of transmission: By grafting (Guicciardi 1831).

Properties: Not determined.

Remarks:
Original report by Guicciardi (1831) has not been seen but according to Moretti (1841) and Atanasoff (1935), variegation was transmitted to green oleander by grafting.

Literature:
Atanasoff, D. Old and new virus diseases of trees and shrubs. Phytopath. Zeitschr. 8: 197-223. 1935.
Guicciardi, Hyacinthi. De nonnullus physiologico-botanicis animadversionibus quae retrogradum lymphae vegetabilis motum respiciunt. (Dissertationes Ticinenses praeside Guiseppe Moretti). Ticini, typ. Fusi. 22 p. 1831.
Moretti, G. Isis von Oken 1841: 584. 1841.

ORNITHOGALUM-MOSAIC VIRUS

Name: Marmor scillearum Smith & Brierley 1944

Synonyms: Bulb-plant-mosaic (virus) Atanasoff 1928 (in part)
Ornithogalum-mosaic virus Smith & Brierley 1944

Common name: Ornithogalum-mosaic virus.

Geographic distribution: United States, Holland? Probably general.

Host range: LILIACEAE--Galtonia candicans Decne., Hyacinthus orientalis L., Lachenalia sp., Ornithogalum thyrsoides Jacq., (?Eucomis undulata Ait.).

Symptoms: Mild green mottling in leaves, blotching in flower stalks, thin streaks in perianth segments.

Methods of transmission: By sap (with difficulty). By Aphis gossypii Glover, Macrosiphum lilii Monell, M. solanifolii Ashm., Myzus circumflexus Buckt., M. persicae Sulz. Not through seed.

Properties: Not determined.

Remarks:
Allium cepa L., Lilium formosanum Stapf, L. longiflorum Thunb. are insusceptible.

Literature:
Atanasoff, D. Mosaic disease of flower bulb plants. Bul. Soc. Bot. Bulgarie 2: 51-60. 1928.
Smith, Floyd F., and Brierley, P. Ornithogalum mosaic. Phytopath. 34: 1944 (in press).

(PAEONIA) PEONY-MOSAIC VIRUS

Name: Paeonia Virus 1 (Dufrenoy) Smith 1937
Peony mosaic disease (virus) Whetzel 1915

Synonyms: Peony infectious chlorosis virus Fukushi 1932
Peony-ringspot virus Green 1935
Peony mosaic virus Guterman 1935

Common name: Peony-mosaic virus.

Geographic distribution: Canada (Coulson), Denmark, England (Green), France, Japan (Fukushi), United States.

Host range: RANUNCULACEAE--Paeonia sp. SOLANACEAE--Nicotiana tabacum L., Petunia sp. (Dufrenoy 1934).

Symptoms: In Paeonia, yellow rings, irregular patches or mottle, occasionally small necrotic spots (illustrated by Green, Guterman). In Nicotiana tabacum, necrotic primary spots, followed by necrosis along petioles and stems, with dwarfing and death of the plant (Dufrenoy 1934). In Petunia, dwarfing and mosaic (Dufrenoy 1934).

Methods of transmission: By sap, peony to tobacco and petunia (Dufrenoy 1934).

Properties: Not determined.

Remarks:

Peony mosaic is widespread, but the only claim of transmission is that by Dufrenoy (1934) who states that sap inoculations from the chlorotic areas induced symptoms in tobacco and petunia, but similar inoculations from adjacent green areas did not.

Literature:

Coulson, J. G. Peony diseases. Rept. Quebec Soc. Prot. Plants 15 (1922-23): 67-70. 1923.

Dufrenoy, J. Un virus des Renonculacées transmissible au Nicotiana tabacum. Compt. rend. Soc. Biol. Paris 117: 346-348. 1934.

Fukushi, T. A contribution to our knowledge of virus diseases of plants. Trans. Sapporo Nat. Hist. Soc. 12: 130-141. 1932.

(Gram, E., et al.) Plantessygdommer i Danmark 1932. Oversigt, samlet ved Statens plantepatologiske Forsøg. Tidsskr. for Planteavl. 39: 453-506. 1933. (RAM 13: 151. 1934).

Green, D. E. A suspected virus disease of Paeonies new to Great Britain. Gard. Chron. 98: 213. 1935.

Guterman, C. E. F. Peony diseases. In Cornell Agric. Ext. Bull. 321: 32-43. 1935.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 5

Whetzel, H. H. Diseases of the peony. Trans. Mass. Hort. Soc. 1915 (1): 103-112.

PASSIFLORA-FRUIT-WOODINESS VIRUS

Name: Marmor passiflorae Holmes 1939
Passiflora Virus 1 (Noble) K. M. Smith 1937

Synonyms: Passion fruit woodiness (virus) Cobb 1901
Passion fruit bullet disease virus Noble 1928

Common name: Passiflora-fruit-woodiness virus

Geographic distribution: Australia, England (?) (Bewley 1923), Kenya (?) (Storey 1940).

Host range: PASSIFLORACEAE--Passiflora coerulea L., P. edulis Sims

Symptoms: In Passiflora edulis, leaves dwarfed, curled, deformed, with yellowish chlorosis or light and dark green mottling; stems mottled; fruits dwarfed, misshapen or spherical, their surface often cracked and sometimes exhibiting irregular protrusions, characteristically firm, with a tough rind due to thickening and lignification of the cell walls of the pericarp. Symptoms are more severe in cooler months.

Methods of transmission: By sap (Noble 1928).

Properties: Not reported.

Literature:

Bewley, W. F. Mycological Report. Eighth Ann. Rep. Cheshunt Exper. and Res. Sta. Herts. (1922): 34-45. 1923.

Cobb, N. A. Woodiness of passion fruit. Agr. Gaz. New South Wales 12: 407-418. 1901.

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 77-78.

Noble, R. J. Some observations on the woodiness or bullet disease of passion fruit. Journ. & Proc. Roy. Soc. New South Wales 62: 79-98. 1928

_____ Woodiness of the passion fruit. Cause of the disease discovered. Agr. Gaz. New South Wales 39: 681-683. 1928.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 51.

Storey, H. H. Plant Pathology. E. Afr. Agric. Res. Sta., Amani, Ann. Rept. 1939: 8-11. 1940

PASSIFLORA-VARIEGATION VIRUS

Name:

Synonyms:

Common name: Passiflora-variegation virus

Geographic distribution: England, France.

Host range: PASSIFLORACEAE--Passiflora quadrangularis aucubaefolia, P. kermesina Link & Otto (P. raddiana), P. vitifolia HBK., P. Impératrice Eugénie (a supposed hybrid of P. coerulea)(Lemoine 1875).

Symptoms: Leaf variegation.

Methods of transmission: By grafting (Bradley 1717, 1726, Lemoine 1875).

Properties: Not determined.

Literature:

Atanasoff, D. Old and new virus diseases of trees and shrubs. Phytopath. Zeitschr. 8: 197-223. 1935.

Bradley, R. New improvements of planting and gardening. 2: 129. (London ?) 1717. (Cited by Atanasoff)

_____ A generale treatise on husbandry and gardening. 1: 282, 283; 2: 129. London 1726. (Cited by Atanasoff).

Lemoine, M. (Reviewed in Gard. Chron. n.s. 3: 81. 1875).

PELARGONIUM-LEAF-CURL VIRUS

Name: Pelargonium Virus 1 (Pape) Smith 1937

Synonyms: Pelargonium curl disease (virus ?) Pape 1927
Geranium-mosaic virus Verplancke 1932
Geranium crinkle virus Jones 1938
Geranium leaf-curl virus Jones 1940

Common name: Pelargonium-leaf-curl virus

Geographic distribution: Belgium, Canada, Czechoslovakia, England, Germany, United States.

Host range: GERANIACEAE--Pelargonium hederaceum, P. hortorum Bailey, P. zonale (L.) Soland.

Symptoms: Pale chlorotic leaf-spots, becoming bright yellow stellate or dendritic blotches, finally necrotic. Leaves crinkled, dwarfed. Symptoms are more intense under hot, dry conditions, but often mask on further growth (Pethybridge & Smith 1932). Symptoms mask in summer (Jones).

Methods of transmission: By grafting (Pethybridge & Smith 1932, Verplancke 1932, Berkeley 1938, Jones 1940). Symptoms after 28-40 days (Pethybridge & Smith 1932, Jones 1940). Not by sap (Pethybridge & Smith 1932, Verplancke 1932, Bremer 1933, Jones 1940). Not through soil (Verplancke 1932). Not through seed (Jones 1940).

Properties: Not determined.

Remarks:

Pelargonium leaf-curl appears to be a distinctive virus disease. Additional symptom types in Pelargonium are described by Pape (1928), Verplancke (1932), Bremer (1933), Blattný (1933), and Jones (1940). See also Pelargonium-mosaic virus. Verplancke (1932) reports sap transmission of a Pelargonium virus to tobacco, and production of symptoms in Pelargonium with "mosaic of tobacco."

Literature:

Berkeley, G. H. Leaf curl of Geranium. Canad. Hort. (Floral ed.) 61: 108. 1938

Blattný, C. Virové choroby Pelargonií. Ochrana Rostlin 13: 145. 1933. (RAM 13: 378)

Bremer, H. Zur Kräuselkrankheit der Pelargonien. Blumen u. Pflanzenb. 48: 32-33. 1933.

Jones, L. K. Crinkle and mosaic of geranium. Phytopath. 28: 11. 1938 (Abst.)

_____ Leaf curl and mosaic of geranium. Washington Agric. Expt. Sta. Bull. 390. 19 pp. 1940.

Pape, H. Das verheerende Auftreten der Kräuselkrankheit bei Pelargonien. Die Gartenwelt 31: 329-331. 1927.

_____ Eine Begleiterscheinung bei der Kräuselkrankheit der Pelargonien. Gartenw. 32: 116-117. 1928.

Pethybridge, G. H., and Smith, K. M. A suspected virus disease of zonal Pelargoniums. Gard. Chron. 92: 378-379. 1932.

Pirone, P. P. Geranium crinkle in New Jersey. U. S. Bur. Plant Indus. Plant Disease Reporter 22: 146. 1938.

_____ Leaf crinkle of geranium. U. S. Bur. Plant Indus. Plant Disease Reporter 24: 129-131. 1940.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 48.

_____ The virus diseases of glasshouse and garden plants. Sci. Hort. 4: 126-140. 1936.

S(orauer), P(aul). Die Kräuselkrankheit bei den Pelargonien. Zeitschr. Pflanzenkr. 26: 193-194. 1916.

Verplancke, G. Une maladie à virus filtrant du "Pelargonium zonale." Bul. Cl. Sci. Acad. Roy. de Belgique. Sér.5, 18: 269-281. 1932.

PELARGONIUM-MOSAIC VIRUS

Name:

Synonyms: Geranium-mosaic virus Jones 1938

Common name: Pelargonium-mosaic virus

Geographic distribution: United States and Canada (Jones 1940), Czechoslovakia (Blattný 1933).

Host range: GERANIACEAE--Pelargonium hortorum Bailey

Symptoms: Light and dark green mottling in leaves, the pale areas usually large, irregular, and interveinal. Dwarfing. Symptoms mask in summer. (Jones)

Methods of transmission: By grafting, symptoms after 28 to 40 days. Not by sap. Not through seed. (Jones 1940).

Properties: Not determined.

Remarks:

Symptoms similar to Jones' (1940) Pelargonium mosaic are described by Pape (1928), Verplancke (1932), and Blattný (1933), but no sound inferences can be drawn as to the synonymy of the viruses concerned. Verplancke (1932) distinguishes leaf curl, interveinal mosaic, and oily spot symptoms, but implies that these are merely phases of one disease, as all three classes produced similar symptoms on graft transfers. Blattný (1933) distinguishes aucuba mosaic and interveinal chlorosis, the latter transmissible by grafting. Jones (1940) considers Blattný's interveinal chlorosis similar to his geranium mosaic.

Literature:

Blattný, C. Virové choroby Pelargonií. Ochrana Rostlin 13: 145. 1933. (RAM 13: 378)

Jones, L. K. Crinkle and mosaic of geranium. Phytopath. 28: 11. 1938. (Abst.)

_____ Leaf curl and mosaic of geranium. Washington Agric. Exp. Sta. Bull. 390. 19 pp. 1940.

Pape, H. Ein Begleiterscheinung bei der Kräuselkrankheit der Pelargonien. Gartenwelt 32: 116-117. 1928.

Verplancke, G. Une maladie à virus filtrant du "Pelargonium zonale." Bul. Cl. Sci. Acad. Roy. de Belgique. Sér. 5, 18: 269-281. 1932.

PEPEROMIA-RINGSPOT VIRUS

Name:

Synonyms:

Common name: Peperomia-ringspot virus

Geographic distribution: Illinois.

Host range: PIPERACEAE--Peperomia obtusifolia A. Dietr.

Symptoms: Plants are stunted, leaves distorted and disfigured by systemic chlorotic or brown necrotic rings.

Methods of transmission: By grafting. No insect vector is known.

Properties: Not determined.

Literature:
Creager, D. B. Ring spot of popular Peperomias caused by virus. Flor. Rev. 87 (2256): 15-16. 1941.

PETUNIA-MOSAIC VIRUS

Name:

Synonyms:

Common name: Petunia-mosaic virus

Geographic distribution: Japan, United States.

Host range: SOLANACEAE--Lycopersicon esculentum Mill., Nicotiana alata Link & Otto (N. affinis), X N. sanderae W. Wats., N. tabacum L., Petunia sp. (Matsumoto & Hirane 1939). Nicotiana glauca Graham, N. glutinosa L., N. rustica L., Petunia violacea Lindl., Physalis pubescens L., Solanum nigrum L. PHYTOLACCACEAE --Phytolacca decandra L. (Johnson 1926)

Symptoms: In Petunia, clearing of veins in the incipient stage, followed by light and dark green mottling, and often blistering or savoying. Mild mottling in other hosts listed. No cellular inclusions are formed. (Matsumoto & Hirane 1939).

Methods of transmission: By sap.

Properties: Withstands dilution 1:50, not 1:100. Filterable through Berkefeld N filters. Apparently unable to produce antiserum in rabbits; serologically unrelated to tobacco-mosaic virus (Matsumoto & Hirane 1939).

Remarks:
Of two strains of petunia mosaic found in Taihoku, one is identical with tobacco-mosaic virus, the other, described here, is serologically distinct, lacks inclusion bodies, and is considered similar to the petunia mosaic of Hoggan (1927), which lacked intracellular inclusions (Matsumoto and Hirane 1939). Hoggan states that her petunia mosaic is that described by Johnson (1926).

Literature:
Hoggan, Isme A. Cytological studies on virus diseases of Solanaceous plants. Journ. Agric. Res. 35: 651-671. 1927.
Johnson, J. Mosaic diseases on differential hosts. Phytopath. 16: 141-149. 1926.
Matsumoto, T. Differentiation of two Petunia mosaic diseases by means of serological, cytological, and inoculation experiments. Bot. & Zool. 3 (5): 893-898. 1935. (Japanese) (RAM 14: 699).
_____, and Hirane, S. Two strains of Petunia mosaic. Trans. nat. Hist. Soc. Formosa 29 (184-185): 1-12. 1939.

PHLOX-STREAK VIRUS

Name:

Synonyms:

Common name: Phlox-streak virus

Geographic distribution: Canada (New Brunswick).

Host range: POLEMONIACEAE--*Phlox* sp.

Symptoms: Faint vein-clearing. Severe necrosis of the collenchyma in veins and petioles, with distortion of the leaf-blades. Streaking in leaves and stems.

Methods of transmission: By grafting. Not by sap.

Properties: Not determined.

Literature:
McLeod, D. J. *In* Conners, I. L. Twenty-first Ann. Rept. Canadian Plant Disease Survey, 1941 xviii + 102 pp. 1942. p. 96

PHYTOLACCA-MOSAIC VIRUS

Name:

Synonyms: Pokeweed mosaic virus Allard 1918
Phytolacca decandra mosaic virus Fernow 1925

Common name: Phytolacca-mosaic virus.

Geographic distribution: United States

Host range: PHYTOLACCACEAE--*Phytolacca decandra* L.

Symptoms: Mosaic mottling, sometimes leaf distortion also (Allard 1918). Intracellular inclusions are occasional (Smith 1926).

Methods of transmission: By sap (Allard 1918, Fernow 1925, Johnson 1930). Not through seed (Allard 1918). Symptoms in 12 to 15 days (Allard 1918).

Properties: Not determined.

Remarks:
Phytolacca decandra is susceptible to other viruses, but the virus commonly occurring in this species is non-transmissible to tobacco or to other solanaceous plants (Allard 1918, Fernow 1925, Johnson 1930)

Literature:
Allard, H. A. The mosaic disease of Phytolacca decandra. Phytopath. 8: 51-54. 1918.
Fernow, K. H. Interspecific transmission of mosaic diseases of plants. New York Cornell Agr. Exp. Sta. Memoir 96: 3-34. 1925.
Johnson, E. M. Virus diseases of tobacco in Kentucky. Kentucky Agr. Exp. Sta. Bull. 306: 289-415. 1930.
Smith, Fanny F. Some cytological and physiological studies of mosaic diseases and leaf variegations. Ann. Missouri Bot. Gard. 13: 425-484. 1926.
Woods, A. F. Observations on the mosaic disease of tobacco. U. S. Dept. Agr. Bur. Plant Indus. Bull. 18. 24 pp. 1902. Pl. II.

PITTOSPORUM-VARIEGATION VIRUS

Name:

Synonyms:

Common name: Pittosporum-variegation virus

Geographic distribution: California, France

Host range: PITTOSPORACEAE--Pittosporum daphniphylloides Hayata, P. tobira Dryand.

Symptoms: Dwarfing; systemic chlorotic mottling and distortion of leaves (Milbrath). Yellow variegation (Carrière).

Methods of transmission: By grafting(Carrière). By patch bark graft (Milbrath).

Properties: Not determined.

Remarks:
Carrière reports two instances in which scions of the yellow-variegated Pittosporum tobira variegatum set in the green variety transmitted variegation to the stocks although the buds died. The symptoms of Milbrath's virus disease (illustrated) seem distinct from Carrière's, but the two are grouped pending more complete data.

Literature:
Carrière, E. A. Influence du greffon sur le sujet. Revue Horticole 59: 58-59. 1887.
Milbrath, D. G. Probable virus disease of Pittosporum daphniphylloides. California Dept. Agr. Bull. 29: 158-159. 1940.

PRIMULA-MOSAIC VIRUS

Name:

Synonyms: Primula obconica mosaic virus Tompkins & Middleton

Common name: Primula-mosaic virus

Geographic distribution: United States (California).

Host range: PRIMULACEAE--Primula malacoides Franch., P. obconica Hance, P. sinensis Lindl.

Symptoms: Prominent leaf mottling, with irregular dark green islands on light green to yellow ground, upward cupping, distortion, and sometimes shoestring effects in leaves. Conspicuous breaking in petal color; mottling of the calyx. Leaves, flowers, petioles, and peduncles reduced in size, with severe general stunting.

Methods of transmission: By sap (symptoms after 16 to 21 days). No vector is known. Not through seed.

Properties: Thermal inactivation point between 48° and 50°C. Resists aging 24 hours, not 48 hours, at 22°C. Dilution tolerance 1:10.

Remarks:

In parallel trials distinct from cucumber-mosaic virus in symptom expression in Primula, and in host range. No infection in 46 species representing 42 genera in 23 families, except in the 3 Primula spp. listed. Repeated efforts to infect tobacco failed. Myzus persicae failed to transmit this virus. The many other references to mosaic in Primula cited by Tompkins and Middleton cannot be assigned to this virus on the information available.

Literature:

Tompkins, C. M., and Middleton, John T. A mosaic disease of Primula obconica and its control. Journ. Agr. Res. 63: 671-679. 1941.

PRUNELLA-MOSAIC VIRUS

Name:

Synonyms:

Common name: Prunella-mosaic virus

Geographic distribution: Finland.

Host range: LABIATAE--Prunella vulgaris L.

Symptoms: Yellowish-green mosaic spotting, malformation, and dwarf-

ing in leaves; plants often die prematurely.

Methods of transmission: By sap. By aphids (undetermined). Not through seed. (Symptoms after 1 to 2 months or longer).

Properties: Not determined.

Remarks:
Aphids from various Compositae and from Lathyrus transmitted the virus, but aphids from Silene and from Apium did not. The author considers several species of aphids were effective as vectors, but only mass cultures were tested, and no aphids are named.

Literature:
Liro, J. I. Über die Mosaikkrankheit der Prunella vulgaris. Ann. Soc. Zool.-Bot. Fenn. Vanamo, 11: 143-149. 1930.

(PRUNUS) FLOWERING-CHERRY-ROUGH-BARK VIRUS

Name: Rimocortium Kwanzani Milbrath & Zeller

Synonyms: Prunus virus 9 Milbrath & Zeller

Common name: Flowering-cherry-rough-bark virus

Geographic distribution: Oregon.

Host range: ROSACEAE--Prunus serrulata Lindl. var. Kwanzan. Mazzard (P. avium L.) seedlings can carry the virus without symptoms.

Symptoms: Dwarfing, with few lateral branches and short internodes. Bark roughened by longitudinal splitting. Leaves crowded together, arched downward by defective development of the midribs, which often show longitudinal and transverse cracking.

Methods of transmission: By budding.

Properties: Not determined.

Literature:
Milbrath, J. A., and Zeller, S. M. Rough-bark, a virus disease of flowering cherry. Phytopath. 32: 428-430. 1942.

PTELEA-VARIEGATION VIRUS

Name:

Synonyms: Ptelea infectious chlorosis (virus) Baur 1907

Common name: Ptelea-variegation virus

Geographic distribution: Germany

Host range: RUTACEAE--Ptelea trifoliata L.

Symptoms: Green and yellow leaf variegation

Methods of transmission: By grafting (Baur) and by budding (Reuter).

Properties: Not determined.

Remarks:
The ornamental variety Ptelea trifoliata foliis variegatis is affected with this virus disease, but the aurea form is not (Baur 1907), but Reuter (1870) reported an aurea form transmissible.

Literature:
Baur, E. Über infektiöse Chlorosen bei Ligustrum, Laburnum, Fraxinus, Sorbus und Ptelea. Bericht. d. Deutsch. Bot. Gesellsch. 25: 410-413. 1907.
Reuter. Die Resultate verschiedener Veredlungsarten. Botaniker Zeitung 28: 641-644. 1870.

RHAMNUS-VARIEGATION VIRUS

Name:

Synonyms:

Common name: Rhamnus-variegation virus

Geographic distribution: France.

Host range: RHAMNACEAE--Rhamnus sp. ("Alaterne").

Symptoms: White variegation.

Methods of transmission: By grafting.

Properties: Not determined.

Remarks:
Carrière grafted a white variegated buckthorn on a green stock. Although the graft failed, a bud of the stock 8 to 10 cm. below the graft expressed variegation like the scion variety.

Literature:
Carrière, E. A. Influence du greffon sur le sujet. Revue Horticole 59: 58-59. 1887.

ROBINIA (LOCUST)-BROOMING VIRUS

Name: Chlorogenus robiniae Holmes 1939
Robinia Virus 1 (Hartley & Haasis) Smith 1937

Synonyms: Locust witches' broom (virus) Waters 1898
Black locust brooming disease (virus) Hartley & Haasis 1929

Common name: Robinia (locust)-brooming virus

Geographic distribution: United States--Pennsylvania to Georgia and west to Arkansas (Grant et al. 1942). A similar disease occurs in Germany (Ross 1933).

Host range: LEGUMINOSAE--Robinia pseudo-acacia L.

Symptoms: Proliferation of lateral buds into "brooms" of upright or ascending habit, common on sprouts from roots or stumps, also found on branches of large trees. Brooms often die in winter (Hartley & Haasis 1929). Vein-clearing in leaflets is characteristic of early stages; leaflets are greatly reduced in size and tapered at the base in acute brooming. Petioles are shorter, leaves fall prematurely. Roots are brittle, tend to broom also (Grant, Stout, and Ready 1942.)

Methods of transmission: By grafting (symptoms after 5 months) (Jackson & Hartley 1933). By grafting or budding. Not by sap. (Grant, Stout, and Ready 1942.)

Properties: Not determined.

Remarks:
Symptomless carriers are sometimes induced to develop brooming symptoms when cut back or defoliated (Grant 1939). A similar disease of Gleditsia triacanthos L. is mentioned by Grant and Hartley (1938) but is not reported transmissible.

Literature:

Grant, T. J. Systemic brooming of Robinia pseudoacacia and other virus-like diseases of trees. Phytopath. 29: 8. 1939 (Abst.
_____, and Hartley, C. A witches' broom on black locust and a similar disease on honey locust. U. S. Bur. Plant Indus. Plant Disease Reporter 22: 28-31. 1938.
_____, Stout, D. C., and Ready, J. C. Systemic brooming, a virus disease of black locust. Journ. For. 40: 253-260. 1942.
Hartley, C., and Haasis, F. W. Brooming disease of black locust (Robinia pseudoacacia). Phytopath. 19: 163-166. 1929.
_____, and Jackson, L. W. R. A brooming disease of Robinia pseudoacacia transmitted by grafts. Phytopath. 23: 13. 1933. (Abst.).
Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 13-14.
Jackson, L. W. R., and Hartley, C. Transmissibility of the brooming disease of black locust. Phytopath. 23: 83-90. 1933.
Ross, H. Über nichtparasitäre Hexenbesen an Robinia pseudoacacia L. Ber. d. Deutsch. Bot. Gesellsch. 51: 292-300. 1933.
Smith, K. M. A textbook of plant virus diseases. London 1937. p. 184.
Waters, C. E. Witches' broom on the locust. Plant World 1: 83-84. 1898.

(ROSA) ROSE-MOSAIC VIRUS

Name: Rosa Virus 1 (White) Smith 1937
Marmor rosae Holmes 1939

Synonyms: Rose infectious chlorosis virus White 1928
Rose mosaic virus Weiss & McWhorter 1930

Common name: Rose-mosaic virus

Geographic distribution: United States, England (Smith 1937), Brazil (Kramer 1940, 1940a), Bulgaria (Christoff 1935), France (Vibert 1863).

Host range: ROSACEAE—Rosa canina L., R. eglanteria L. (R. rubiginosa L.) (Vibert 1863), R. gallica L. (Christoff 1935), R. hugonis Hemsl., R. multiflora Thunb., R. nutkana Presl, R. odorata Sweet, R. wichuraiana Crép., Rosa hybrids.

Symptoms: Chlorotic areas feathering away from the midribs of leaflets, often associated with local distortion, also ring, oakleaf, and watermark patterns. Yellow mosaics are characterized by brighter and lighter yellow patterns.

Methods of transmission: By grafting, budding. Not by sap. No vector is known.

Properties: Not determined.

Remarks:

Thomas & Massey (1939) distinguish rose mosaics 1, 2, and 3, of which the first is White's rose mosaic or Rosa Virus 1 (White) Smith 1937, Marmor rosae Holmes 1939. Rose mosaics 2 and 3 are yellow mosaics, separable on the basis of symptom expression in the test varieties Hollywood, Belle of Portugal, and Souvenir de Claudius Pernet. Symptoms were induced in apple with rose mosaic 3 only. Kramer (1940a) has described a yellow mosaic of rose from São Paulo. Brierley and Smith (1940) found no duplicates among 5 collections of yellow mosaic compared on 5 test varieties of rose. The name Rosa virus 2 (Brierley) Smith 1937 is based on these. Evidently a number of strains of rose yellow mosaics could be distinguished on the basis of varietal reactions. However, these may be regarded as strains of rose-mosaic virus, until further information is available. The relation to rose mosaic of Vibert's (1863) variegation of 'Eglantier' (Rosa eglanteria L.), Christoff's (1935) mosaic of R. gallica L., transmissible to apple and pear, and Blattný's (1938) vein mosaic of R. canina, cannot be determined from the evidence available.

Literature:

Baker, K. F., and Thomas, H. Earl. The effect of temperature on symptom expression of a rose mosaic. Phytopath. 32: 321-326. 1942.

Blattný, C. Poznámka o méně známých virových chorobách. Ochrana Rostlin 14: 86-87. 1938. (RAM 17: 543).

Brierley, P. Symptoms of rose mosaic. Phytopath. 25: 8. 1935. (Abst.).

_____, and Smith, Floyd F. Mosaic and streak diseases of rose. Journ. Agric. Res. 61: 625-660. 1940.

_____, and _____ Spread of rose virus diseases. Amer. Nurseryman 72 (1): 5-8. 1940.

Christoff, Alexander. Mosaikfleckigkeit, Chlorose und Stippenfleckigkeit bei Äpfeln, Birnen und Quitten. Phytopath. Zeitschr. 8: (285)-296. 1935.

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 74.

Johnson, E. M., and Valleau, W. D. The ring symptom of virus diseases in plants. Kentucky Agr. Exp. Sta. Bul. 361: (239)-263. 1935.

Kramer, M. O mosaico da roseira. Revista Agricultura 15: 301-311. 1940.

_____ Os mosaicos da roseira no Estado de S. Paulo. Biologicó 6: 365-368. 1940 (a).

McWhorter, F. P. Further report on rose mosaic in Oregon. U. S. Bur. Plant Indus. Plant Disease Reporter 15: 1-3. 1931.

Nelson, R. Infectious chlorosis of the rose. Phytopath. 20: 130. 1930. (Abst.).

Newton, W. Infectious chloroses of the rose. Rep. Dominion Bot. 1930. Div. Bot., Canada Dept. Agric. p. 23. 1931.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 152-154.

Thomas, H. Earl, and Massey, L. M. Mosaic diseases of the rose in California. Hilgardia 12: 647-663. 1939.

Vibert, M. Observations relatives à l'influence qu' exerce la greffe sur le sujet. Journ. Soc. Imp. et Cent. Hort. 9: 144-145. 1863.

Weiss, F., and McWhorter, F. P. Pacific Coast survey for rose mosaic. U. S. Bur. Plant Indus. Plant Disease Reporter 14: 203-205. 1930.

White, R. P. An infectious chlorosis of roses. U. S. Bur. Plant Indus. Plant Disease Reporter 12: 33-34. 1928.

_____ An infectious chlorosis of rose. Phytopath. 20: 130. 1930. (Abst.).

_____ Chloroses of the rose. Phytopath. 22: 53-69. 1932.

_____ The effect of mosaic on bloom production of the Talisman rose. Phytopath. 24: 1124. 1934.

(ROSA) ROSE-STREAK VIRUS

Name: Rosa Virus 4 (Brierley) Smith 1937
Marmor veneniferum Holmes 1939

Synonyms: Rose streak virus Brierley 1935

Common name: Rose-streak virus

Geographic distribution: United States--District of Columbia, Maryland, New York, Texas, Virginia.

Host range: ROSACEAE--Rosa canina L., R. multiflora Thunb., R. nutkana Presl, R. wichuraiana Crép., Rosa hybrids.

Symptoms: Brown rings, brown or yellowish vein-banding in leaves; brownish or greenish ring marking in canes of systemically invaded roses.

Methods of transmission: By grafting, budding. Not by sap. No insect vector is known. Not through seed.

Properties: Not determined.

Literature:

Brierley, P. Streak, a virus disease of roses. Phytopath. 25: 7-8. 1935. (Abst.).

_____, and Smith, Floyd F. Mosaic and streak diseases of rose. Journ. Agric. Res. 61: 625-660. 1940.

_____, and _____ Spread of rose virus diseases. Amer. Nurseryman 72 (1): 5-8. 1940.

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 75.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 155-156.

(ROSA) ROSE-WILT VIRUS

Name: Rosa Virus 3 (Grieve) Smith 1937
Marmor flaccumfaciens Holmes 1939

Synonyms: Rose wilt or die-back virus Grieve 1931
Rose wilt virus Grieve 1942

Common name: Rose-wilt virus

Geographic distrition: Australia, New Zealand (Grieve 1931a), Italy (Gigante 1936).

Host range: ROSACEAE--Rosa hybrids.

Symptoms: Young leaves recurved, crowded, brittle. Defoliation progressing from the tips of stems downward, followed by die-back of the stem tips, and darkening of the bases of young stems. Intracellular inclusions present (Gigante 1936, Grieve 1942).

Methods of transmission: By sap (Grieve 1931, Gigante 1936). By budding (Grieve 1931a). Possibly by aphis (Grieve 1931). By Macrosiphum sp. (Gigante 1936). Symptoms after 10 to 20 days (Grieve 1931a).

Properties: Passes Seitz filter that retains Bacillus pyocyaneus (Grieve 1931). Gives no precipitin reaction (Mushin 1942).

Remarks:

Gigante (1936) distinguished his virus from rose-wilt virus by the characters (1) blackish-brown spots and light brown necrotic areas in leaves, (2) flower deformations, (3) necrosis of medullary rays, (4) intracellular bodies in leaves, and (5) transmissibility by aphids. Grieve has subsequently (1942) shown that points (3) and (4) apply also to rose-wilt virus, while a single transfer for which he did not claim significance (1931) indicated aphid transmission also.

Literature:

Gigante, R. Una nuova virosi della rosa in Italia. Boll. R. Staz. Pat. veg. N.S. 16: 76-94. 1936. (RAM 16: 179-180. 1937).

Grieve, B. J. "Rose wilt" and "die-back". A virus disease of roses occurring in Australia. Austral. Journ. Exp. Biol. and Med. Sci. 8: 107-121. 1931.

_____ Rose wilt and die-back disease. In Rose diseases and their control. Journ. Dept. Agric. Victoria 29: 363-365. 1931 (a).

_____ Further observations on rose wilt virus. Proc. Roy. Soc. Victoria 54: 229-242. 1942. (Biol. Absts. 17: ent. 14693).

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 73-74.

Mushin, Rose. Serological studies on plant viruses. Austral. Journ. Exp. Biol. and Med. Sci. 20: 59-63. 1942. (RAM 21: 425).

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 154-155.

(RUMEX) DOCK-MOSAIC VIRUS

Name:

Synonyms: Rumex obtusifolius mosaic virus Fernow 1925
Dock infectious chlorosis virus Grainger 1929

Common name: Dock-mosaic virus

Geographic distribution: England, United States.

Host range: POLYGONACEAE--Rumex lanceolatus Thunb., R. obtusifolius L.

Symptoms: In Rumex obtusifolius, fine regular mottling (Fernow); diffuse yellowish-green mottling figured by Grainger. No conspicuous stunting or other effects except leaf mottling. Chlorotic areas sometimes confined to interveinal spaces, sometimes in large patches, the two types apparently distinct (Grainger).

Methods of transmission: By sap (Fernow, Grainger).

Properties: Not determined.

Remarks:
The viruses studied by Fernow and Grainger appear to be the same or similar, from the limited data published. Fernow found no other plants susceptible among many tested.

Literature:
Fernow, K. H. Interspecific transmission of mosaic diseases of plants. New York Cornell Agric. Exp. Sta. Mem. 96: 3-34. 1925.
Grainger, J. An infectious chlorosis of the dock. Proc. Leeds Phil. & Lit. Soc., Sci. Sect. 1: 360. 1929.

(SAMBUCUS) ELDER-MOSAIC VIRUS

Name:

Synonyms:

Common name: Elder-mosaic virus

Host range: CAPRIFOLIACEAE--Sambucus nigra L., S. canadensis L.

Geographic distribution: Czechoslovakia, Germany, Denmark, United States (Martin 1925).

Symptoms: Leaves show a dark yellowish-green veining. Plants are dwarfed with few, mostly sterile flowers.

Methods of transmission: By Aphis sambuci (Blattný).

Properties: Not determined.

Literature:
Blattný, C. Poznámky o virových a příbuzných chorobách rostlin. I. (Notes on virus and similar diseases of plants I.) Ochrana Rostlin 10: 130-138. 1930. (RAM 10: 328-329. 1931).
(Gram, E., et al.) Plantesygdommer i Danmark 1932. Oversigt, samlet ved Statens plantepatologiske Forsøg. Tidsskr. for Planteavl. 39: 453-506. 1933. (RAM 13: 151. 1934).
Martin, G. H. Diseases of forest and shade trees, ornamental and miscellaneous plants in the United States in 1924. U. S. Bur. Plant Indus. Plant Disease Reporter Suppl. 42: 313-380. 1925.
Smith, K. M. A textbook of plant virus diseases. London 1937. p. 556.

(SENECIO) CINERARIA-STREAK VIRUS

Name:

Synonyms:

Common name: Cineraria-streak virus Jones 1942

Geographic distribution: United States.

Host range: COMPOSITAE—Senecio cruentus (Mass.) DC.
SOLANACEAE—Lycopersicon esculentum Mill.

Symptoms:

Methods of transmission: By sap to tomato. By seed.

Properties: Not reported.

Remarks:
Jones (1942) reports 2 virus diseases of Cineraria, mosaic and streak, are often carried in the seed, and that the streak virus is mechanically transmissible to tomato.

Literature:
Jones, L. K. Virous diseases of Cineraria. In Fifty-second Annual Report for the fiscal year ended June 30, 1942. Washington Agric. Exp. Sta. Bull. 425: 73-74. 1942.

SORBUS-VARIEGATION VIRUS

Name: Pyrus Virus 1 (Baur) Smith 1937

Synonyms: Infectious chlorosis Baur 1907
Infectious chlorosis Hertzsch 1930
Pyrus variegation virus Atanasoff 1935

Common name: Sorbus-variegation virus

Geographic distribution: Germany.

Host range: ROSACEAE—Sorbus aucuparia L. (Pyrus aucuparia)

Symptoms: Yellow or white variegation, sometimes vein-clearing and vein-banding (Smith).

Methods of transmission: By grafting.

Properties: Not determined.

Literature:
Atanasoff, D. Old and new virus diseases of trees and shrubs. Phytopath. Zeitschr. 8: 97-223. 1935
Baur, E. Über eine infektiöse Chlorosen bei Ligustrum, Laburnum, Fraxinus, Sorbus und Ptelea. Ber. d. Deutsch. Bot. Gesellsch. 25: 410-413. 1907.
_____ Beiträge zur infektiöse Chlorose. Zeitschr. f. Bot. 20: 65-86. 1927.
Hertzsch, W. Infektiöse Chlorose. Der Züchter 2 (8): 195-198. 1930.
Smith, K. M. A textbook of plant virus diseases. London 1937. p. 149

TABEBUIA-WITCHES'-BROOM VIRUS

Name:

Synonyms:

Common name: Tabebuia-witches'-broom virus.

Geographic distribution: Puerto Rico

Host range: BIGNONIACEAE--Tabebuia pallida (Lindl.) Miers

Symptoms: Brooming--numerous shoots with short internodes, thickened nodes, and small leaves. Few flowers are developed, and the broomed shoots die prematurely.

Methods of transmission: By budding. Not by sap. No insect vector is known. Not through seed.

Properties: Not determined.

Literature:

Cook, M. T. The witches' broom of Tabebuia pallida in Puerto Rico. Journ. Agric. Univ. Puerto Rico 22: 441-442. 1938.

Smith, K. M. A textbook of plant virus diseases. London 1937. p. 558.

(TULIPA) TULIP-BREAKING VIRUS

Names: Tulipa virus 1 (Cayley) Smith 1937 (emended Brierley and Smith 1944).
Marmor tulipae Holmes 1939 (emended Brierley and Smith 1944).

Synonyms: Tulip breaking (virus) Griffiths and Juenemann 1919
Tulip breaking virus McKay 1926
Flower bulb mosaic disease virus Atanasoff 1928 (in part)
Tulip breaking (virus) Cayley 1928a, 1928b
Tulip breaking virus McKay, Brierley and Dykstra 1929
Tulip breaking virus McKenny Hughes 1930
Mosaique des Tulipes virus Dufrenoy 1931
Tulip breaking virus Cayley 1932
Tulip breaking virus McWhorter 1932.
Variegatura del tulipano Gigante 1938
Tulip breaking virus Brierley and McKay 1938
Tulip white break (virus) McKenny Hughes 1931
Tulip clear break (virus) Cayley 1932
Tulip full break, clotted break (viruses) McKenny Hughes 1934
Tulip virus I (color removing) McWhorter 1934, 1938
Marmor mite Holmes 1939

Tulip red break (virus) McKenny Hughes 1931
Tulip self break (virus) Cayley 1932
Tulip self break (virus) McKenny Hughes 1934
Tulip virus II (color adding) McWhorter 1934, 1938
Marmor tulipae Holmes 1939
Lilium auratum mosaic virus Guterman 1928 (?)
Lily mosaic virus Guterman 1930 (in part)
Lilium speciosum mosaic virus Tasugi and Ikeno 1935 (?)
Lily latent virus McWhorter 1937
Easter lily strong mottle virus Brierley 1939
Tulip virus (in lily) Brierley 1940
Lily mosaic virus Gadd and Loos 1940 (in part ?)
Lily mottle viruses Brierley and Smith 1944a

Common name: Tulip-breaking virus

Geographic distribution: Widespread in tulip. Allied types widespread in lilies.

Host range: LILIACEAE--Tulipa gesneriana L., T. clusiana DC., T. eichleri Regel, T. greigi Regel, T. linifolia Regel (Cayley 1932); Lilium auratum Lindl. (Guterman 1928); L. longiflorum Thunb. (Ogilvie and Guterman 1929); Fritillaria sp., Lilium canadense L., L. speciosum Thunb., L. superbum L., L. tigrinum Ker-Gawl. (Guterman 1930); L. candidum L. (McWhorter 1937); L. formosanum Stapf (Brierley 1939); L. amabile Palib., L. bulbiferum L. subsp. croceum (Chaix) Baker, L. cernuum Komarov, L. chalcedonicum L., L. dauricum Ker-Gawl., L. elegans Thunb., L. giganteum Wall., L. henryi Baker, L. leucanthum Baker, L. myriophyllum Franch. var. superbum (Baker) Wils., L. regale Wils., L. sargentiae Wils., L. tenuifolium Fisch. (L. pumilum DC)., L. testaceum Lindl., L. umbellatum Hort. (Brierley 1940); Calochortus sp., Fritillaria pudica (Pursh) Spreng., Zigadenus fremontii (Torr.) S. Wats. (Brierley and Smith 1944a). One lily virus strain affects Ornithogalum thyrsoides Jacq., but no hosts outside Liliaceae are recognized by Brierley and Smith (1944a). Other species of Lilium reported susceptible to "lily mosaic" by various writers are probably susceptible to a virus of the tulip-breaking group, but cucumber-mosaic virus may be involved also in such reports.

Symptoms: In tulips, "breaking" of the flower color in the form of striping, flaming, or feathering. In the "average break" characteristic of commercial Rembrandt tulips both intensification and bleaching of the anthocyanic pigment appear in different areas. In "self breaks" (color-adding, Tulip virus 2) this pigment is intensified in stripes. In "full break" (color removing, Tulip virus 1) this pigment is removed from some areas, exposing the ground color of the flower, which is white or yellow according to the variety (Cayley 1928, Longley 1935, McWhorter 1938a). White- and yellow-flowered varieties do not break unless some trace of anthocyanin pigment is present. Some dark red varieties develop "self breaks" even when infected with color removing virus (McWhorter 1938a,b).

Tulip leaves are mottled by Tulip virus 1 and some lily virus strains, but not by Tulip virus 2. The chlorotic areas contain small chloroplasts poor in chlorophyll (Dufrenoy 1931, Gigante 1938). Inclusion bodies are present (Gigante 1938, McWhorter 1938a, 1940), but characterize Tulip virus 1 and are lacking in Tulip virus 2 infections (McWhorter 1938a).

In Easter lily, mottling with distortion, mottling only, or no symptoms according to the strain of the virus involved. In Lilium formosanum severe or mild mottling. In L. tigrinum mild mottling, soon masked, or yellowing and death from certain strains. In other Lilium spp., mottling usual, necrosis and death occasional. (Brierley and Smith 1944a.) Inclusion bodies occur in some species of Lilium (Tasugi and Ikeno 1935), but apparently not in all (Gadd and Loos 1940). Inclusion bodies induced in tulips serve to distinguish certain lily strains of the virus (McWhorter 1940).

Methods of transmission: By bulb grafting (Cayley 1928). By sap (Atanasoff 1928, McKay et al. 1929). By Anuraphis (Aphis) tulipae B. de Fonsc. (McKenny Hughes 1934). By Aphis fabae Scop. and A. gossypii Glover (Brierley and Smith 1944a). By Macrosiphum solanifolii Ashm. (=M. gei Koch, = Illinoia solanifolii Ashm.) and Myzus persicae Sulz. (McKenny Hughes 1930, 1931, 1934, Brierley and McKay 1938), possibly by Myzus circumflexus (Buckt.) (Brierley and McKay 1938) and Myzus solani (Kalt) (= M. pelargonii Sulz.) (McKay et al. 1929). Not through seed. Symptoms after 11 to 38 days in tulips inoculated in early stage of growth, or in second season if inoculated late (Brierley and Smith 1944a).

Properties: Determined in tulip, thermal inactivation point between 65° and 70°C, infectious in dilutions up to 1:100,000, withstands drying in leaves 11 days, resistant to alcohol (McWhorter 1935). Properties of Tulip virus 1 and 2 are the same (McWhorter 1938).

Determined in Lilium formosanum, physical properties vary with the different strains: thermal inactivation points between 60° and 65°C (or 55° and 60°C), dilution end points 1:10,000 (or 1:10), withstands aging at 18°C 6 days (or 4 days), infectious after drying on cloth for 6 hours (or less than 2 hours) (Brierley and Smith 1944a).

Remarks:

According to Hoog (1933) the transmissibility of tulip breaking by bulb grafting was known to Dutch bulb growers as early as 1637. Blagrave (quoted by McKay and Warner 1933) gave directions for inducing breaking by bulb grafting in 1675. Breaking patterns are recognizable in illustrations published as early as 1576 (McKay and Warner 1933).

Color-removing and color-intensifying variants of the usual breaking pattern in tulips were described by Cayley (1932) and by McKenny Hughes (1934). McWhorter (1934, 1938) noted that these sub-types tend to segregate in the vegetative increase of inoculated tulips. He obtained relatively pure strains of color-adding virus (Tulip Virus 2) and color-removing virus (Tulip Virus 1) from such segregates, and termed them "antithetic viruses" because of their contrasting effects in tulips. The

physical properties of these two viruses, determined in tulips, are identical (McWhorter 1935); but, determined in Lilium formosanum, they differ slightly (Brierley and Smith 1944a). Holmes (1939) gave the name Marmor tulipae to McWhorter's Tulip virus 2, and Marmor mite to McWhorter's Tulip virus 1 and Lily latent virus (McWhorter 1937).

Lily-mosaic virus (Guterman 1928, 1930) was first considered distinct, but later reduced to synonymy with cucumber-mosaic virus by Price (1937) whose interpretation was accepted by Smith (1937) and gained wide usage. It has been subsequently shown (Brierley 1939, 1940) that cucumber-mosaic virus is less prevalent in lilies than viruses of the tulip-breaking type, and that cucumber-mosaic virus is important in lilies chiefly as an essential constituent of the necrotic-fleck complex in Lilium longiflorum (Brierley and Smith 1944b). The mottling viruses thus far studied in lilies appear to be sufficiently close to the classical tulip-breaking virus to fall in the same virus species (Brierley and Smith 1944a).

Literature:

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Brierley, P. Two distinct viruses from the mosaic complex in Lilium longiflorum. Phytopath. 29: 3. 1929. (Abst.).

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_____ Current season development of virus symptoms in tulips. Phytopath. 31: 838-843. 1941.

_____, and McKay, M. B. Experiments with aphids as vectors of tulip breaking. Phytopath. 28: 123-129. 1938.

_____, and Smith, Floyd F. Studies on lily virus diseases: the mottle group. Phytopath. 34: 1944 (a) (in press).

_____, and _____ Studies on lily virus diseases: the necrotic fleck complex in Lilium longiflorum. Phytopath. 34: 1944 (b) (in press).

Cayley, D. M. "Breaking" in tulips. Gard. Chron. 83: 435-436. 1928 (a).

_____ "Breaking" in tulips. Ann. Appl. Biol. 15: 529-539. 1928 (b).

_____ "Breaking" in tulips II. Ann. Appl. Biol. 19: 153-172. 1932.

Dufrenoy, J. Mosaique des tulipes. Compt. rend. Soc. Biol. 108: 51-53. 1931.

_____ Die Viruskrankheiten. Phytopath. Zeitschr. 5: 85-90. 1932.

Gadd, C. H. and Loos, C. A. Lily mosaic. Trop. Agric. Ceylon 94: 160-167. 1940.

Gigante, R. La variegatura del tulipano. Boll. R. Staz. Patol. Veg. Roma 18 (n.s.): 429-454. 1938.

Griffiths, D., and Juenemann, H. E. Commercial Dutch-bulb culture in the United States. U. S. Dept. Agric. Bull. 797. 50 pp. 1919.

Guterman, C. E. F. A preliminary report on mechanical transmission of the mosaic of Lilium auratum. Phytopath. 18: 1025-1026. 1928.

_____ Diseases of lilies, for the lily disease investigation fellowship. Hort. Soc. New York Yearbk. 1930: 51-102.

Holmes, F. O. Handbook of phytopathogenic viruses. Minneapolis 1939. p. 52-54

Hoog, J. The breaking of tulips. Gard. Chron. 94: 471. 1933

Longley, L. E. Flower color in "broken" or mosaic tulips. Proc. Amer. Soc. Hort. Sci. 33: 674-677. 1935.

McKay, M. B. Narcissus and tulip diseases. Ann. Rept. Oregon State Hort. Soc. 18: 137-150. 1926.

_____, Brierley, P., and Dykstra, T. P. Tulip "breaking" is proved to be caused by mosaic infection. U. S. Dept. Agric. Yearbk. 1928: 596-597. 1929.

_____, and Warner, M. E. Historical sketch of tulip mosaic or breaking, the oldest known plant virus disease. Nat. Hort. Mag. 12: 179-216. 1933.

McKenny-Hughes, A. W. Aphis as a possible vector of "breaking" in tulip species. Ann. Appl. Biol. 17: 36-42. 1930.

_____ Aphides as vectors of "breaking" in tulips. Ann. Appl. Biol. 18: 16-29. 1931.

_____ Aphides as vectors of "breaking" in tulips. Ann. Appl. Biol. 21: 112-119. 1934.

McWhorter, F. P. A preliminary analysis of tulip breaking. Phytopath. 22: 998. 1932. (Abst.).

_____ The properties and interpretation of tulip-breaking viruses. Phytopath. 25: 898. 1935. (Abst.).

_____ A latent virus of lily. Science 86: 179. 1937.

_____ The antithetic virus theory of tulip-breaking. Ann. Appl. Biol. 25: 254-270. 1938 (a).

_____ Correlation between self-breaking and blue nuclei among certain commercial tulip varieties. Science 88: 411. 1938 (b).

_____ Separation of Tulip 1 virus from lily-latent by cytological methods. Phytopath. 30: 788. 1940. (Abst.).

Ogilvie, L., and Guterman, C. E. F. A mosaic disease of the Easter lily. Phytopath. 19: 311-315. 1929.

Pape, H. Die Mosaikkrankheit der Lilien. Gartenwelt 37: 324-325, 364. 1933.

Price, W. C. Classification of lily mosaic virus. Phytopath. 27: 561-569. 1937.

Smith, K. M. A textbook of plant virus diseases. London 1937. 410-415.

Tasugi, H., and Ikeno, S. On the intracellular bodies associated with the mosaic disease of the lily (Preliminary report). Ann. Phytopath. Soc. Japan 5: 30-43. 1935. (Japanese-English resume).

(ULMUS) ELM-MOSAIC VIRUS

Name:

Synonyms: (?) Elm mottle mosaic virus (Blattný 1938)
Elm mosaic virus (Swingle, Tilford, and Irish 1941).

Common name: Elm-mosaic virus

Geographic distribution: Bulgaria (Atanasoff 1935), Czechoslovakia (Blattný 1938), England (Swailes 1887), United States (Swingle, Tilford, and Irish 1941).

Host range: ULMACEAE--Ulmus americana L., U. campestris L. (Swailes 1887), U. glabra Huds., U. pumila L. (Rankin 1931).

Symptoms: Yellow and green mottling, rugosity, distortion of leaves. Slight brooming of branches. Brittleness of branches. Some leaf buds may fail to expand, leaving intervals of bare branches and a tufted aspect. (Swingle, Tilford, and Irish 1941, 1943.)

Methods of transmission: By grafting (Swailes 1887). By patch-bark grafts. Not by sap. Not by root grafts. (Swingle, Tilford, and Irish 1941, 1943.) Symptoms in the following season.

Properties: Not determined.

Remarks:

The variegation in Ulmus campestris that Swailes (1887) illustrated and transmitted by grafting may differ from the mosaic of U. americana of Swingle et al. (1941, 1943). Swingle et al. (1943) cite no other authors. Evidence of natural spread in Ohio is reported.

Literature:

Atanasoff, D. Old and new virus diseases of trees and shrubs. Phytopath. Zeitschr. 7: 197-223. 1935.

Blattný, C. Poznámka o méně známých virových chorobách. Ochrana Rostlin 14 (55): 86-87. 1938. (RAM 17: 543).

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Swailes, G. The influence of scion on stock. Gard. Chron. III, 2: 284, 368. 1887.

Swingle, R. U., Tilford, P. E., and Irish, C. F. A transmissible mosaic of American elm. Phytopath. 31: 22. 1941. (Abst.)

_____, _____, and _____ A graft transmissible mosaic of American elm. Phytopath. 33: 1196-1200. 1943. illus.

(ULMUS) ELM-PHLOEM-NECROSIS VIRUS

Name:

Synonyms: Elm phloem necrosis virus Swingle 1938

Common name: Elm-phloem-necrosis virus

Geographic distribution: United States.

Host range: ULMACEAE--*Ulmus americana* L., possibly *U. fulva* Michx.

Symptoms: General aspect of sparse foliage on upper and outer branches. Leaves drooping, lateral margins curled upward, later yellowish-green to yellow, finally dropping or drying in place. Phloem necrosis in roots and lower trunk, yellow to yellowish-brown at first, later dark brown with the odor of wintergreen. Occasionally fatal in 3 or 4 weeks, usually fatal in 12 to 18 months. (Swingle 1942.)

Methods of transmission: By grafting. Not by sap. Not by soil. Symptoms in 6 to 24 months. (Swingle 1938, 1942.)

Properties: Not determined.

Literature:

Leach, J. G., and Valleau, W. D. Two reports on phloem necrosis of elm. U. S. Bur. Plant Indus. Plant Dis. Reporter 23: 300-301. 1939.

Swingle, R. U. A phloem necrosis of elm. Phytopath. 28: 757-759. 1938.

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